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Contents for April 6, 1933

VOLUME 110, NUMBER 14

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Conservation Camps and the Tennessee Basin 425
BY S. T. HENRY and IRVIN FOOS

Shallow Beams of Bridge at Allentown Incased in Gunite... 430
BY EARLE W. MECKLEY

Heat Evolved by Cement in Relation to Strength 431
BY HUBERT WOODS, H. H. STEINOUR and H. R. STARKE

Roller-Compacted Pavement Shows Economy 434
BY GEORGE W. LANGLEY, JR.

Dust-Explosion Tests Suggest New Building Practices 436

Novel Bridge Renewal on an Indian Railway 437

Reappraising the Work of the Engineering College 438
BY H. S. ROGERS and R. A. SEATON

Public-Works Construction Needs Coordination 441
BY HENRY H. WILSON

Letters 442
Editorials 444
News 446
Equipment 451
Business Notes 452
Materials and Prices 454

◆

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Vol. 110 New York, April 6, 1933 No. 14

Land Conservation and Unemployment.425
Bridge Uses Gunite-Incased Beams....430
Low-Heat Cement—One-Year Results.431
Roller-Compacted Concrete Pavement..434
Dust-Explosion Tests 436
Bridge Renewal in India..............437
Reappraising the Engineering College.438
Coordination of Public Works........441
Results from New Quake Instruments..442
Letters to the Editor.................443
Editorials 444
News of the Week 446
Business News 452
Materials and Prices 454

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The Land-Conservation Camp Plan and the Tennessee River Basin

Main features of the plan for unemployment-relief camps in federal forest reserves and a survey of the area most prominently discussed as the scene of a great experiment in regional planning.

By S. T. Henry and Irvin Foos
Southeastern and Washington Representatives of Engineering News-Record

TWO PHASES of the unemployment-relief program being planned by the federal government have occasioned widespread comment because of their striking originality. These are the proposal to establish labor camps in federal forest reserves, affording immediate employment to upwards of a quarter of a million men, and the plan to embark on a great regional planning and industrial development scheme in the Tennessee River Basin. The latter area also contains extensive national forests in which some of the conservation camps will be located.

What is the scope of this conservation camp plan? What is required to get it under way? Where would the camps be located? How large would they be and what work would the men perform? These are some of the questions relating to the first phase of the program, a bill for which was signed by the President on March 31. Relative to the Tennessee Valley regional plan, the essential question is: What is available as its basis in the way of climatic conditions, topography, flood conditions, power sites, transportation needs and industrial possibilities? This article attempts an answer to some of these questions, for they will be widely discussed.

A tributary valley to the Tennessee River basin in the Nantahala National Forest in southwestern North Carolina. This is typical of the mountainous forest preserves in which the federal government proposes to establish its conservation camps.

The Congressional measure under which the conservation scheme will operate, according to present plans, authorizes the President to give jobs to the unemployed "in the construction, maintenance and carrying on of works of a public nature in connection with the forestation of lands belonging to the United States or to the several states which are suitable for timber production, the prevention of forest fires, floods and soil erosion, plant pest and disease control, the construction, maintenance and repair of paths, trails and fire-lanes in the national parks and national forests and such other work on the public domain and government reservations as the President may determine to be desirable." It is also stipulated that the President may extend the provisions of the act to lands owned by counties and municipalities and lands in private ownership, when the work would be in the public interest. The President is further authorized "to provide for housing the persons so employed, and for furnishing them with such subsistence, clothing, medical attention and hospitalization and cash allowance as may be necessary."

Forest conservation was chosen by President Roosevelt as a means of creating employment that would not conflict with either public works or private construction activity and that would put a large number of men to work in a short time at small expense. He frankly regards the employment provided by this type of work as only a drop in the bucket compared to the broader public-works program that he contemplates. But it is some employment, it is useful, and it is immediate. At the same time it serves to keep public attention focused on relief requirements until the other parts of the program can be brought into play.

Work contemplated

The Forest Service has mapped out a program anticipating ten years' needs which, at the rate of its present appropriations, could not be encompassed in 50 years. The National Park Service also has prepared a work schedule susceptible of immediate expansion. By type of organization and experience in seasonal operation and fire-fighting, both agencies are able to put a large number of men to work within a week or ten days after their enrollment at the large recruit camps to be set up by the Department of Labor, with the use of army facilities.

The work in the national forests will include the stringing of telephone lines, building minor roads and trails, landing-fields, firebreaks, lookout towers, range fences, water holes, improvements at public camp sites and many activities related to insect and blister-rust control and forest and range culture. The National Park Service program is similar to that of the Forest Service. As to other public lands, there is little prospect that much work will be done, as the activities of the General Land Office are limited to surveying.

As a first step in the program R. Y. Stuart, chief of the Forest Service, will call a conference of federal and state forest officials to select the areas in which to commence work. In the national forests alone there is, he says, enough work to keep 250,000 men busy. A recent estimate by the Forest Service puts the direct work immediately available for unemployment relief at about 1,300,000 man-months. An incomplete estimate of work available on state, municipal and cooperative private land is 415,000 man-months.

Thousands of men now are at work in forest camps. Many of these are employed at going wages out of the $10,000,000 emergency fund made available to the Forest Service for the current year, but more have been recruited by the relief agencies in several states for employment in return for shelter and subsistence. Experience in the California labor camps has demonstrated that recruits include everybody from civil engineers to pick-and-shovel men. If physically fit, it is not long before they qualify as axmen, cat-drivers, planters, graders, powder men, time keepers, etc.

Camps near centers of population

Recruiting and enrollment at concentration camps in the neighborhood of the large cities is regarded as necessary to relieve unemployment where it is most acute. Without such organization the job hunters would have to beat their way to uncertain destinations, and orderly manning of the forest camps would be difficult. It is expected that enrollment lists will be opened promptly, probably within two or three weeks. After a few days in the concentration camps for classification according to physical fitness and their qualifications, the men will be dispatched to the small camps established by the supervisors of the national forests and parks.

Trail-building is one type of work that is counted upon to supply the men in the conservation camps with jobs. View is in the Cherokee National Forest.

No priorities will be set up, but obviously, says Mr. Stuart, work will commence first in areas that are most accessible. Camps of approximately 100 men each will be located with reference to carrying on a variety of activities at the same time. In penetrating the woods, stand improvement and fire-control work are pushed forward with construction of the so-called truck trails and minor trails.

Of some 161,000,000 acres embraced in the 145 national forests, 135,000,000 acres lie in the West, excluding Alaska, and only 7,500,000 acres in Eastern states. Most of the 177,000,000 acres in the public domain, 71,000,000 acres in Indian reservations, 8,000,000 in national parks and more in other federal and state lands also are remote from the heavily populated districts but are embraced by the terms of the law.

In order to obtain wider geographical distribution of activity and at the same time more effective concentration than the location of the national forests and parks permits, the bill was amended, on recommendation of Mr. Stuart, to include county, municipal and privately owned land for cooperative work, now provided for by law, in preventing and controlling forest fires and diseases and floods. Stand improvement work will be confined, however, to federal and state-owned land. The emergency program will avert a very serious situation, as appropriations by states and subdivisions for forest protection have been stripped bare.

In the North the work season does not open normally until May 1, but men can be put to work in the lower foothills immediately. From the concentration camps in the East the men will go to the White Mountains, the large state forests of New York and Pennsylvania and the national forests that embrace 800,000 acres in the watershed of the Tennessee basin. Close to Chicago and Detroit are the vast devastated forest lands of the Lake states. On the Pacific Coast there is a string of national forests running practically the entire length of the Cascade and Coast ranges and the Sierras. Putting men to work in the Rockies will necessitate long hauls, and transportation is a major element of cost in the program.

The men can be fed for 35c. a day, but the total cost per man, including food, will be 80c. to $1 per day, to cover transportation, tentage, sanitation, bedding and clothes, medicine, hand tools, kitchenware and cooks, foremen, time keepers and others directly related to overhead. The revised bill refers only to a cash allowance, without specifying the amount; the original declared that the men were to be paid at the rate of $1 a day.

Funds available from unobligated

balances of appropriations for public works are estimated at $148,000,000. This is, in reality, a concealed appropriation for the forestation program, as the law authorizes for appropriation for the same projects, at a later date, the money that is diverted now to forests.

The Tennessee River basin

As is generally known, the Tennessee River basin is one of the principal areas to which the conservation camp plan is to be applied. Extensive opportunities exist in this basin for power development, flood control, reforestation and the more economical use of marginal argicultural lands, as was shown by a full study of the region made three years ago by the Corps of Engineers.

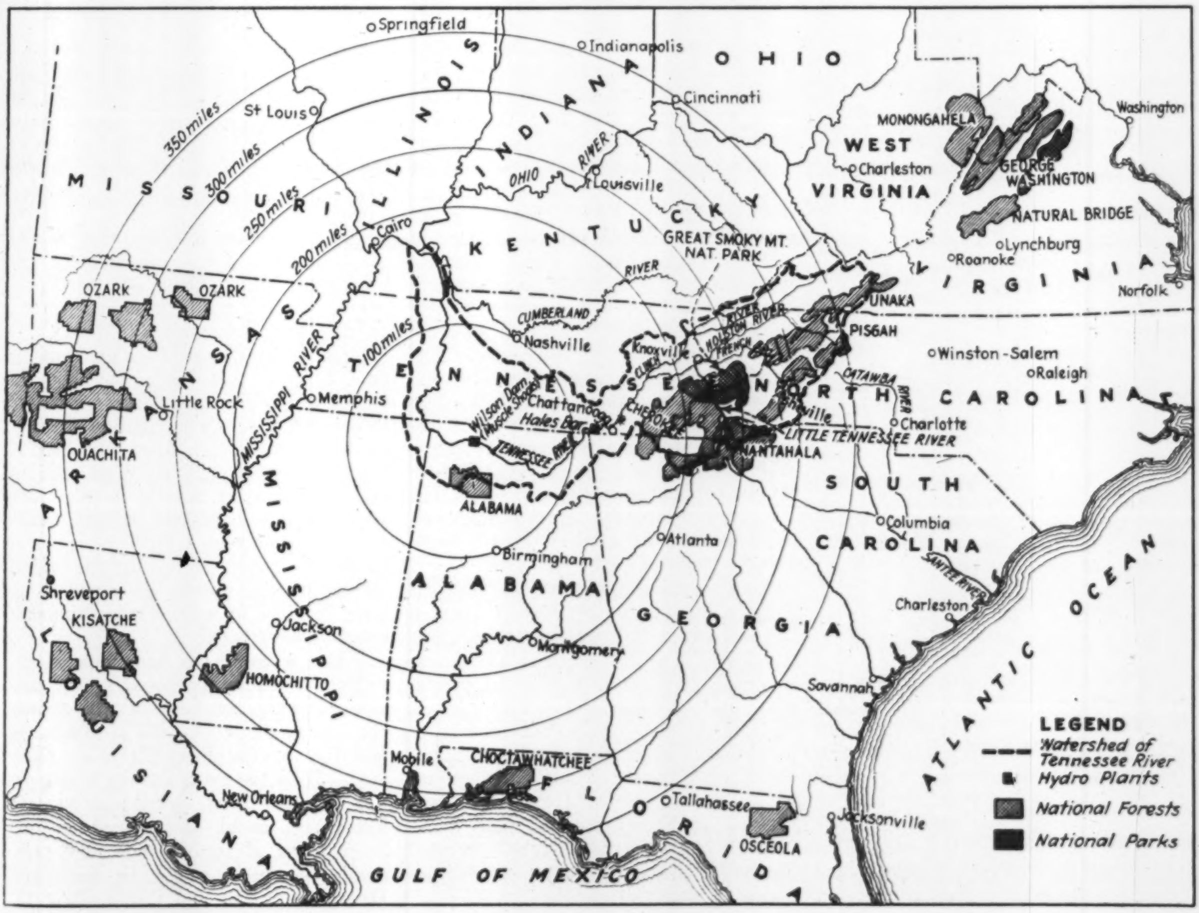
There are about 1,000,000 acres of government lands in forest reserves and national parks on the headwaters of the Tennessee. Very little reforestation, road and trail construction has been done on these vast areas, which far exceed all other similar government lands in the East. Plans are ready, however, to permit reforestation, trail and road work to be started immediately on a large scale.

Essentially, the findings of the army engineers' survey, as reported to Congress in 1930, are applicable today. Greatly lowered land prices and reduced construction and mechanical equipment costs since then would modify downward the estimated outlay, and improved methods of production of power by steam likewise would alter favorably some of the recommendations.

From its confluence with the Ohio River near Paducah, Ky., to the point in east Tennessee where it is formed by the French Broad and the Holston, the Tennessee River has a total length of 652 miles and a fall of over 500 ft. Its drainage area is 40,600 square miles. Widely varying conditions occur in this watershed, including a range from 312 ft. above sea level at the Ohio to the highest mountains in the East at the headwaters, where several peaks exceed 6,500 ft. and large areas are above the 5,000-ft. level.

Rainfall is heavy, ranging from 45 to 58 in., with an average of 51.8 in. annually over the entire area. Distribution of rainfall during the year ordinarily is comparatively uniform, but there are wide variations from year to year and frequent periods of drought and excessive runoff. Only 22.4 in. of the total rainfall finds its way to the stream, while 28.8 in. is lost by plant transpiration and evaporation during the warm months. Surface runoff amounts to 16 in. annually, and the remaining 6.4 in. comes from groundwater storage. Some idea of the magnitude of the water resources of the watershed may be drawn from the fact that the deep groundwater storage is estimated to provide some 13,000,000 acre-ft. annually.

Streams, existing power plants, principal cities and federal forest reserves in the Tennessee River basin, where some of the conservation camps will be located. This area has been prominently discussed also as the scene of a great experiment in regional planning centering on Muscle Shoals and including as one of the first projects a regulation dam at Cove Creek on the Clinch River north of Knoxville.


Springfield
Indianapolis
OHIO
Cincinnati
St Louis
350 miles
300 miles
250 miles
200 miles
100 miles
MISSOURI
ILLINOIS
INDIANA
OHIO RIVER
Louisville
KENTUCKY
Cairo
GREAT SMOKY MT. NAT. PARK
RIVER
CUMBERLAND
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Knoxville
CLINCH
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PISGAH
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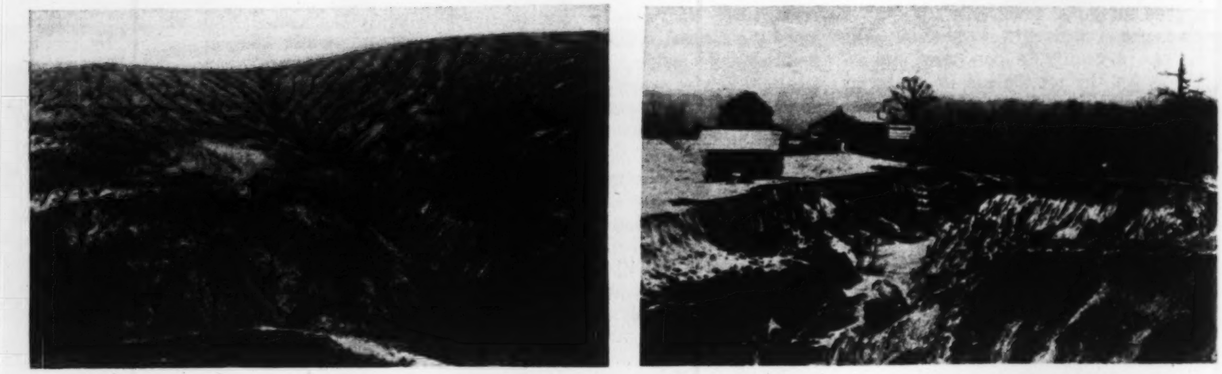
Raleigh
NORTH CAROLINA
CATAWBA RIVER
Charlotte
Asheville
LITTLE TENNESSEE RIVER
NANTAHALA
CHEROKEE
OZARK
OZARK
ARKANSAS
MISSISSIPPI RIVER
Memphis
Little Rock
OUACHITA
TENNESSEE
Wilson Dam (Muscle Shoals)
Chattanooga
Hales Bar
TENNESSEE RIVER
ALABAMA
SOUTH CAROLINA
Columbia
Atlanta
Birmingham
ALABAMA
SANTEE RIVER
Charleston
Shreveport
KISATCHE
Jackson
MISSISSIPPI
HOMOCHITTO
Montgomery
GEORGIA
Savannah
ATLANTIC OCEAN
LOUISIANA
Mobile
CHOCTAWHATCHEE
FLORIDA
Tallahassee
New Orleans
Jacksonville
OSCEOLA
GULF OF MEXICO
LEGEND
Watershed of Tennessee River
Hydro Plants
National Forests
National Parks

Due to the topography of the watershed, the surface runoff is relatively fast. This is especially true in large areas of the upper reaches of the tributaries, where steep mountain slopes and narrow valleys combine to concentrate flow quickly. Farther down the country flattens out, but very little of the watershed is level and there are few swamps. The flow of the main stream therefore has great extremes. At Florence, Ala., near the existing Muscle Shoals hydro development, the minimum of record is 4,300 sec.-ft., while a floodflow of 481,000 sec.-ft. has been noted at that point. These relative differences occur on the entire river.

Water power possibilities

Fairly complete investigations were made by the Corps of Engineers of all the practical sites of power and storage dams on the main river and its tribu-



Reforestation as an aid to soil conservation is a major element in the proposed plan. View at left shows erosion caused by deforestation in the hills of Ducktown Basin in southeastern Tennessee. At right is a close-up of a small streambed that is enlarged after every rain.

taries that have not already been developed or acquired by private interests for development. These include 149 projects, with certain auxiliary steam stations. The complete system, utilizing the entire stream, was estimated to produce about 3,000,000 kw. of firm power under a 50 per cent load factor, at a generating cost of 4⅓ mills per kw. hr. (at 1930 costs). In arriving at this figure the entire cost of the system for navigation, power development and flood control was charged to power, except the cost of locks, barge lifts and channel work required solely for navigation. Elimination of certain uneconomical projects would permit development of power at lower rates.

Markets for any such large amounts of power as could be produced do not exist in the territory to which delivery might practicably be made. In fact, the large privately owned public utilities in the adjacent territory have had surplus capacities at all times in recent years, except for short periods of record droughts. With ample electric energy available at rates to the consumer considerably lower than the rates of private companies, there appear to be large opportunities for the development of extensive manufacturing industries.

Varied and extensive raw-material resources are found in the area, within easy transmission distances of the principal power sites. The raw materials include limestone, coal, salt, copper, zinc, iron, phosphate rock, China clay, feldspar, ball clay and other products entering into industries that can use large amounts of cheap power. From immediately adjacent sections vast quantities of timber, both hardwood and softwood, could be obtained for process industries. Cotton byproducts for cellulose are at hand.

A chance for industries

An outstanding example of what has been done in the way of establishing electro-metallurgical works in the basin is the undertaking of the Aluminum Company of America. That company has hydro projects in operation and planned for early completion on the Little Tennessee River in North Carolina that will almost completely regulate and utilize the potential power of that important tributary of the Tennessee River. These hydro developments have made possible in east Tennessee some of the largest aluminum production and processing plants in the world. The plants are in small communities where there were previously no industries.

Electric firing of ceramics is understood also to offer an outlet for large amounts of cheap power. Fertilizer production has been much discussed in connection with the government power and nitrate plants at Muscle Shoals. Competent authorities believe that nitrate could not be produced by these obsolete plants to compete with more modern installations. But modern plants manufacturing various fertilizing materials would find very favorable conditions if the basin were developed.

Ample and cheap electric power might result in the creation of a great industrial district in the Tennessee River basin over a period of years. What has actually occurred in the Carolinas in the last 25 years in that direction indicates the possibilities. The almost complete regulation and utilization of the Catawba River by the Duke Power Co. has resulted in a remarkable industrial growth in those states since 1910. The growth came largely through numerous relatively small plants scattered over a wide area. There is no city of over 90,000 population in the two states, but practically no town in the industrial sections lacks an industry recently made possible by cheap electric power.

Similar recent development of local industries is also found in the Tennessee River basin. For example, two great rayon plants at Elizabethton, Tenn., one at Enka, N. C., and a large paper and chemical process plant at Canton, N. C., have found local power, labor and other conditions satisfactory. There are many other smaller plants that have sprung up in recent years. Hence, the suggestion of the President, that many small industrial centers might be created in the basin, has the background of accomplished fact.

Several combinations of the more economical hydro and storage projects of the basin scheme have been proposed for construction and operation as rapidly as markets could be created for the power produced. One of these embraces two existing dams on the Tennessee, two to be built on that stream and three to be built on tributaries. With this combination and suitable steam auxiliaries, it has been estimated that 692,800 kw. of firm power with a 50 per cent load factor could be produced at an average (1930) cost of 3.51 mills per kw.-hr. With some such initial plan of development, the other more economical projects of the entire scheme might be undertaken as the territory requires.

Navigation and flood control

While power development is the keystone of the whole Tennessee River basin plan, improvement of the river and its tributaries for navigation looms large in the scheme. Ultimate development of the main river for its entire length would be based on a 9-ft. channel. Various methods of dividing the costs of the combined features that would serve for both power development and navigation improvement have been proposed, but in general most of the total expense would be charged to power.

Such studies as have been made public do not show that the traffic in sight would justify the expenditures required to cover the strictly navigation features of the improvement. However, lack of any appreciable depth in most sections of the stream for several months each year is held to have kept through-routes from being built up. With the expected growth of industry following the undertaking of the power development, a large increase in water-borne shipments could be anticipated.

When it comes to flood control resulting from the proposed power and storage dams, the benefits will depend entirely on the works that are built and how the various power plants are operated. With the main storage reservoirs in service, flood levels along the Tennessee would be reduced so that large areas of fertile lands now practically worthless might be reclaimed. Damage to cities and towns along the stream also would be largely eliminated. The effect of the Tennessee development on Mississippi River floods is estimated to be negligible if the system is operated primarily for power production.

So far as the announced plans of the President for extensive reforestation in the Tennessee River basin are concerned, there is plenty of experience to prove the practicability of such plans if properly undertaken and executed. Beginning back in the nineties, the late George Vanderbilt started on a 55,000-acre tract in the mountains of North Carolina one of the most extensive private reforestation projects that has been undertaken in this country. Results on that project show methods that need to be corrected, but they also show that reforestation locally can be done successfully.

Later the government acquired at various times vast acreages of mountain lands as forest reserves on the headwaters of the Tennessee in the mountains of North Carolina, Tennessee and Virginia. The 421,000-acre Great Smoky National Park in North Carolina and Tennessee also has very lately come into the hands of the government.

Forestation

No definite figures exist on the total acreage of private cutover—that is, idle and marginal agricultural lands in the mountains on the headwaters of the Tennessee that are more suited for growing timber than for any other purpose. It seems safe to state, however, that around 5,000,000 acres of such lands could be bought at from $2 to $4 per acre. These are about the prices the government has paid.

Such purchases, however, are unnecessary for the immediate program of reforestation announced by the President. The government already has ample land of the kind, on which much time and labor will be required for reforestation. Moreover, these lands need great mileages of trails, roads and other improvements to permit them to be operated properly as timber-growing areas. Plans for such work have long been held up waiting for the necessary funds. They could be expanded as fast as any practical scheme of execution could be devised with the proposed civilian conservation corps.

Another feature of these great existing areas of government lands on the headwaters of the Tennessee that are suited for reforestation is their comparatively easy access to the larger centers of population of the country. The fact that reforestation operations in them might readily be planned to permit work to be conducted twelve months in the year further favors their immediate utilization in the proposed unemployment-relief plan.

Farther down in the Tennessee River basin are thousands of square miles of country unsuited for farming that also might be reforested satisfactorily. Most of this section was originally heavily timbered. Forests replaced on it would be within easy truck haul of such industries as might locate around and adjacent to the principal proposed power plants.

Both hardwoods and softwoods thrive in most of the basin. Pines, poplar, cucumber, linn and buckeye are native below the line of elevation where spruce, balsam and other cold country conifers make up the virgin stands. Most of the private and public reforestation has been with conifers. It is remarkable also that the white pine and hemlock thrive in large areas originally timbered with hardwoods.

Favorable soil conditions, combined with heavy rainfall and a southern latitude, produce exceptionally rapid growths of timber over most of the basin. In a relatively short time reforested areas begin to produce returns. An unlimited supply of forest products for industry could thus be assured in this area by the President's plans for reforestation. At the same time soil erosion, where it has done the most harm, could be stopped.

Mountain farmers in the area as a class have done little to conserve the fertility of their lands or to prevent erosion. With steep slopes, exceptionally heavy rainfall and almost universal clean cutivation, their small tracts are soon exhausted. The old practice of abandoning a piece of land when it no longer produced well cannot continue because little suitable new land is left. Moreover, profitable farming in these mountains under the most favorable market conditions is limited. On the other hand, most of the mountain lands are ideally suited for timber farming.

No problem of relocation of the scant population has been experienced in the vast areas already acquired by the government. The hill folk make excellent industrial hands and will travel long distances to work. For example, the majority of the employees of the great rayon plants mentioned live on farms and in hamlets and drive 5 to 30 miles daily to the job.

In case the public-works program proposed by the President does include construction of any of the major dams in the Tennessee River basin scheme, clearing of the reservoir sites offers a vast amount of work that could be done by such classes of men as would enlist in the conservation corps. Cove Creek dam on the Clinch River near Knoxville would alone create a reservoir that would flood over 54,000 acres. Much of this area is cutover and second-growth timber that would all have to be removed. Taking the major projects collectively, the reservoir sites to be cleared total an immense area. These tracts are now almost all privately owned, but under present conditions could be acquired as rapidly as clearing work could be done effectively on them.

* * *

Preventing Canal-Bank Erosion on Missouri Levees

AT FREQUENT intervals along main drainage canals that were cut and had to be diverted back of the Birds Point-New Madrid (Mo.) setback levees, surface water is let into the canals by means of corrugated pipe extending some distance out over the slope. By this means the entering drainage water is prevented from forming gullies down the slope of the canal. If the slope is sharp, as is shown in the view of the far side of the canal, no support is essential; otherwise a creosoted timber frame is used. Further to prevent erosion at the entrance to the pipes, a drop concrete inlet, as shown, is provided. Substantial concrete bridges span the canal at highways.

Fig. 1—Surface drainage is led into main drainage ditch through overhanging corrugated culvert.

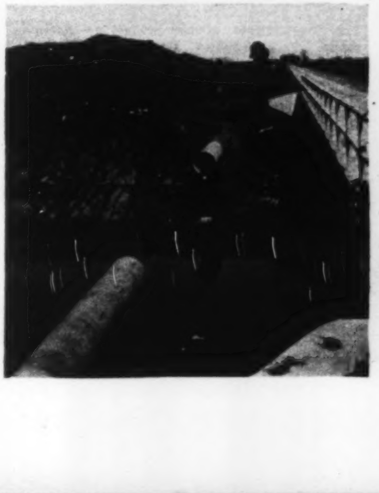
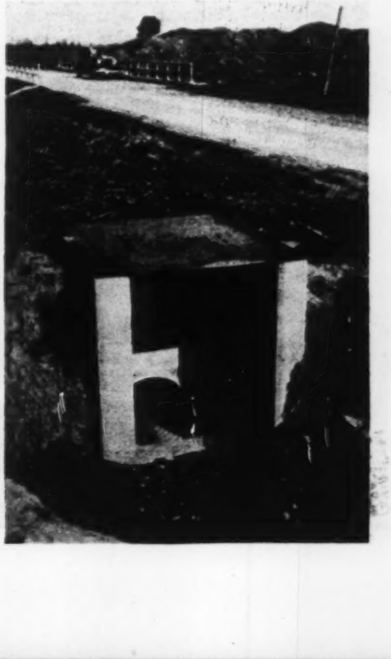


Fig. 2—Drop inlet at entrance to culvert prevents erosion of roadside ditch.



Shallow Bridge Permitted by Reinforced Gunite

Waterway enlarged at low-level stream crossing by incasing twenty 22-in. beams of 53-ft. span in reinforced Gunite

By **Earle W. Meckley**
City Engineer, Allentown, Pa.

FOR A NUMBER of years a direct street connection has been needed on low level between the second and third wards in Allentown, Pa. The two wards are separated by a small stream known as the Little Lehigh Creek. Paralleling the creek is a branch line of the Lehigh Valley Railroad, which serves a number of large industrial plants located immediately adjacent to the stream and railroad.

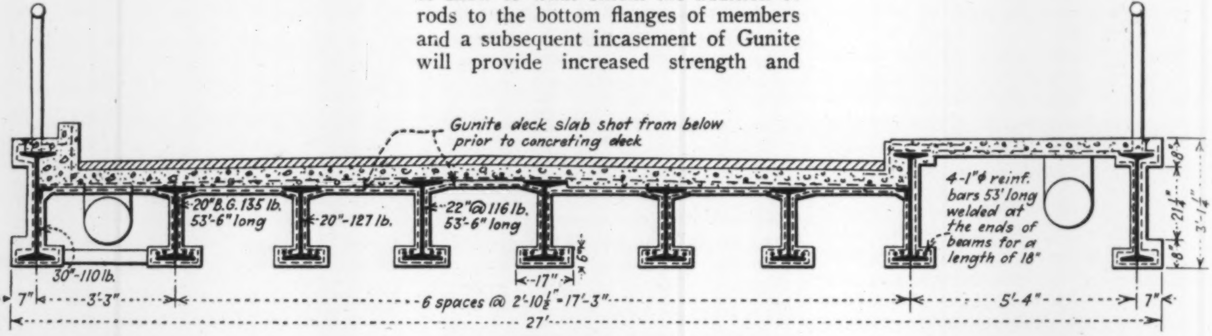

Gunite deck slab shot from below prior to concreting deck
20" B.G. 135 lb. 53'-6" long
20"-127 lb.
22" @ 116 lb. 53'-6" long
4-1"ϕ reinf. bars 53' long welded at the ends of beams for a length of 18"
30"-110 lb.
17"
6"
8"
21¼"
3'-1¼"
8"
7"
3'-3"
6 spaces @ 2'-10½" = 17'-3"
5'-4"
7"
27'

Fig. 1—Transverse section of shallow girder bridge, with bottom-flange reinforcing rods and incasement of Gunite.

The problem facing the city engineers in the design of this structure was to provide a grade-level crossing of the railroad without restricting the flood-flow of the creek, and thus to comply with the regulations of the water and power resources board of the state of Pennsylvania. Calculations and studies showed that in order not to restrict the flow of the stream it would be necessary to provide for a clear waterway of not less than 1,000 sq.ft.

Since it was impracticable to raise the elevation of the existing railroad tracks more than 4 ft., it was decided to use a 53-ft.-span plain girder beam structure with a maximum difference in elevation of 37 in. between the top and bottom of the fascia girders. To obtain the proper roadway section as well as sidewalks, curb and gutter, it was necessary to use 20-, 22- and 30-in. beams of this extreme length.

Realizing that such extreme conditions would probably result in dangerous and uncertain deflections and movement, careful study was made of several methods that might prevent this action. Among these was that referred to in a report made by Professors Clyde T. Morris and J. R. Shank of Ohio State University. *ENR,* April 7, 1927, and Nov. 17, 1927, describes tests made to show to what extent the addition of rods to the bottom flanges of members and a subsequent incasement of Gunite will provide increased strength and stiffness. This method (covered by Patent No. 1,648,801) was finally adopted.

In addition to increasing the resistance against deflection, it was also necessary to decrease the depth of floor slab to a minimum; to do this, it was decided to adopt Gunite supporing slabs as developed on bridges of the Pennsylvania Railroad at Akron, Ohio. These slabs, shot from below against forms laid on top of the girders, were designed sufficiently strong to carry the dead load of the deck so that it was possible to design the concrete deck slab to carry only the live load. The reinforcing steel for this concrete slab was then placed directly against the Gunite slab, and the concrete was poured on top.

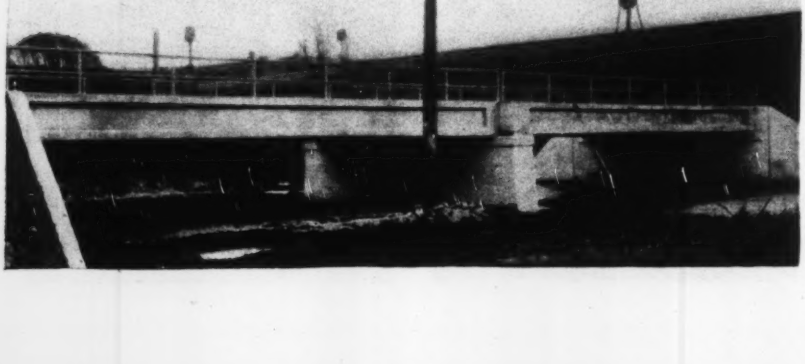


Fig. 2—Shallow girder bridge at Allentown, Pa., showing Gunite finish on fascia girders and large waterway provided.

Fig. 1 shows a cross-section of the bridge and illustrates how the rods necessary to insure the proper increase in stiffness and strength were placed on top of the bottom flanges of the beams prior to placing the bottom incasement. This also shows the method of reinforcing the Gunite deck slab. Due to the possible danger of cracking the fresh Gunite by the addition of the deck loading, it was deemed advisable to specify that the incasement of the bottom flanges should not be made until after the deck slab had been poured and the full dead load applied to the members. This proved succesful, and the maximum deflection on these long members has been less than ½ in.

The question of architectural treatment of steel-girder bridges always demands consideration, and as this bridge is within park area it was very seriously considered. Fig. 2 shows the completed bridge and also the low clearances. The bridge cost $14,000.

The design and erection of this structure has been under the general direction of Earle W. Meckley, city engineer. The general contractor was L. M. Kratz & Son, the Gunite work being done by the Cement Gun Co.

* * *

Government Assistance for Housing Repairs In Germany

To stimulate employment, the German government has set aside 100 million marks (about $23,800,000) to be loaned to house owners who remodel or recondition their homes, according to a report from Berlin. Approval of plans must be obtained from the authorized agencies before commencing work. The money is not paid, however, until work is completed and the bill submitted. The government then will advance up to one-fifth of the total cost.

Loans are restricted to property built before 1918 and on which work was begun before April 1, 1933. They are made through some of the mortgage banks that are allied to or owned by the government, and they are secured by the property itself. The loans are made up to the end of 1934, but it is generally felt that this term may be extended.

Heat Evolved by Cement in Relation to Strength

One-year records of heat evolution and strength development and equations for computing their values — Choice of cements for mass concrete

By Hubert Woods, Harold H. Steinour and Howard R. Starke
Riverside Cement Co., Riverside, Calif.

IN PREVIOUS articles (*ENR*, Oct. 6 and 13, 1932, pp. 404 and 435), the heat evolution and strength development of a group of portland cements of widely varied composition were given for ages up to and including six months. Conclusions were drawn, separately, with respect to the effect of composition on these two properties. In the present article the one-year data on these cements are given; the joint utilization of both the heat and the strength data in the evaluation of cement for massive structures is discussed; and the relationships between strength development and heat evolution are shown graphically.

The cements are laboratory preparations whose heat evolutions have been determined, using neat pastes cured at 95 deg. F., and whose tensile and compressive strengths have been determined in 1:3 standard Ottawa sand mortars cured under water at 70 deg. F. A constant water-cement ratio of four-tenths by weight was used for both the heat and the strength specimens.

Table I gives the one-year results together with clinker constitution and other pertinent data.

In Table II are shown the results of the least-square analysis of the heat data, in which the contribution of each per cent of each of the principal chemical compounds in a cement (Bogue, *Ind. Eng. Chem.*, Analytical Edition 1, p. 192, 1929) has been calculated, together with its probable error (an error of such magnitude that the chance of making an error greater than it, in a given case, is equal to the probability of making one less than it). The table also includes an equivalent analysis in terms of oxide composition. The probable error in the heat evolution, calculated for a cement by means of the factors obtained in either of these analyses, amounts to ± 1.55 calories per gram.

Discussion of heat data

Comparing these one-year heat results with those reported earlier (*ENR*, Oct. 6, 1932, p. 404), they appear to be reasonably consistent, except that for some unknown reason the $4CaO.Al_2O_3.Fe_2O_3$ value is lower than would normally have been anticipated.

In the previous article it was shown that the heat evolved by the laboratory cements correlated well with the function: per cent tricalcium silicate plus 2.1 times per cent tricalcium aluminate. That this correlation is also good at one year is shown by Fig. 1.

TABLE I — ONE-YEAR HEAT AND STRENGTH DATA OF SAMPLE CEMENTS

Cement Number	Specific Surface Sq.Cm. per Gm.	Heat of Hardening at 95°F, Cal. per Gm.	Strength of 1:3 Standard Sand Mortar, Lb./Sq.In. Tensile	Strength of 1:3 Standard Sand Mortar, Lb./Sq.In. Compressive	Clinker Analysis, Per Cent CaO	Clinker Analysis, Per Cent SiO_2	Clinker Analysis, Per Cent Al_2O_3	Clinker Analysis, Per Cent Fe_2O_3	Clinker Analysis, Per Cent MgO	Clinker Compounds, Per Cent (Calculated) $4CaO\ Al_2O_3\ Fe_2O_3$	Clinker Compounds, Per Cent (Calculated) $3CaO\ Al_2O_3$	Clinker Compounds, Per Cent (Calculated) $2CaO\ SiO_2$	Clinker Compounds, Per Cent (Calculated) $3CaO\ SiO_2$	SO_3 in Cement, Per Cent
2122	1,390	85.5	498	7,790	64.97	27.68	3.76	1.98	2.48	6.0	6.6	59.7	26.0	1.5
2123	1,450	76.0	462	7,161	63.15	25.96	3.48	5.06	2.32	15.4	0.7	52.4	29.2	1.5
2092	1,470	110.4	...	....	65.02	21.86	5.75	2.77	5.04	8.4	10.6	20.4	56.0	1.5
2088	1,480	90.6	540	5,761	64.18	24.60	5.85	2.80	2.40	8.5	10.8	47.1	31.0	1.5
2096	1,500	103.5	347	7,467	66.57	25.04	3.86	2.11	2.36	6.4	6.7	32.7	51.8	1.5
2085	1,530	109.8	400	6,709	66.47	22.32	6.17	2.85	2.43	8.7	11.5	22.2	55.5	1.5
2086	....	109.5	...	....	66.47	22.32	6.17	2.85	2.43	8.7	11.5	22.2	55.5	1.5
2087	....	113.9	...	....	66.47	22.32	6.17	2.85	2.43	8.7	11.5	22.2	55.5	1.5
2094	1,560	108.0	438	6,617	66.26	20.93	4.64	5.74	2.08	17.5	2.6	6.2	71.3	1.5
2124	1,570	71.6	462	7,912	62.03	23.54	4.83	7.21	2.24	21.9	0.6	44.2	30.9	1.5
2089	1,580	97.0	477	7,254	64.07	21.96	4.65	6.06	2.32	18.4	2.1	22.2	54.0	1.5
2090	1,540	122.7	...	....	66.64	21.44	8.81	1.19	2.48	3.6	21.3	25.7	47.5	1.5
2093	1,600	117.2	...	....	66.64	21.44	8.81	1.19	2.48	3.6	21.3	25.7	47.5	1.5
2125	1,620	83.1	467	8,360	62.72	22.48	5.00	7.46	2.24	22.7	0.6	34.1	40.2	1.5
2095	1,630	115.4	327	6,769	67.03	21.34	6.07	2.93	2.56	8.9	11.1	11.6	65.7	1.5
2091	1,670	116.3	386	6,564	67.71	21.94	5.57	2.68	2.44	8.2	10.2	11.8	67.7	1.5
2170	1,530	62.6	...	....	61.05	25.72	4.12	6.06	2.08	18.4	0.7	61.1	16.7	1.5

It may or may not be significant that the probable error determined for the calculated one-year heat evolution of a cement, ± 1.55 calories, agrees with that at six months in being very appreciably lower than those at the earlier ages. In this connection it is to be noted that the experimental results with commercial cements, which were reported in the earlier article, showed the least differences from the calculated values at the age of six months. However, the one-year data on these cements again show larger differences, although in general less than those at three and seven days. The calculated heats of hardening minus the experimental values are the following at one year, in calories per gram:

Brand 1	+7.6
Brand 2	+3.9
Brand 3	+3.4
Brand 4	+4.7

Data of another sort, which are of interest in this same connection, have been obtained by aging one of the laboratory cements and again testing it. This cement is No. 2,085, which is fairly representative of cements of the present day. It was aged by keeping it in a cloth bag exposed to the air of the laboratory for about six months. At the end of that time it had an ignition loss of 1.82 per cent in contrast to an initial value of 0.65 per cent. Heat data on both fresh and aged cement (at ages up to six months) are given in Table III below.

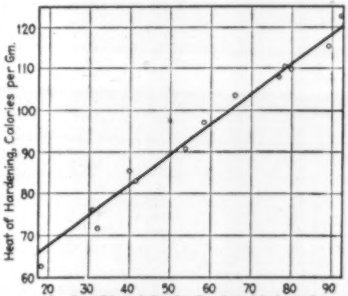


Fig. 1—One-year correlation between heat of hardening and a function of the tricalcium compounds. Graph is based on clinker percentages.

TABLE II—CONTRIBUTION OF INDIVIDUAL COMPONENTS TO HEAT OF HARDENING AT ONE YEAR

(Contribution of each per cent in cement to the heat evolution per gram of cement)

Compound	Calories Value	Calories Probable Error
$3\ CaO.\ Al_2O_3$	2.00	±0.12
$3\ CaO.\ SiO_2$	1.362	±0.033
$4\ CaO.\ Al_2O_3.\ Fe_2O_3$	0.30	±0.11
$2\ CaO.\ SiO_2$	0.621	±0.028
Oxide		
CaO	3.64	
SiO_2	—5.01	
Fe_2O_3	—3.8	
Al_2O_3	—0.7	

TABLE III — HEAT OF HARDENING OF SAME CEMENT FRESH AND AFTER BEING AGED

	Cement No. 2,085 Fresh	Cement No. 2,085 Aged	Cement No. 2,085 Fresh Minus Aged
Initial heat of solution, cal, per gm	618.8	601.4	17.4
3-day heat of hardening, cal. per gm	77.5	64.1	13.4
7-day heat of hardening, cal. per gm	90.3	78.1	12.2
28-day heat of hardening, cal. per gm	101.0	95.8	5.2
3-mos. heat of hardening, cal. per gm	103.7	96.5	7.2
6-mos. heat of hardening, cal. per gm	109.2	109.0	0.2

Although the aged cement shows a much lower heat evolution than the fresh cement at three and seven days, it is considerably closer to it at 28 days and three months, and at six months the agreement is well within the experimental error.

Discussion of strength data

In Fig. 2 the increase in compressive strength between 28 days and one year is compared with the dicalcium-silicate content. A somewhat crude but nevertheless distinct relationship is observable, as was the case at six months.

The tensile strengths are reported in the table but are not believed to be reliable as indications of the behavior of the cements in practice. It is widely conceded that the standard tensile test, in which mortar briquets of small cross-section are stored continuously under water, does not give a true indication of the concrete strength at the greater ages. (See Gonnerman: *Proc.* A.S.T.M., Vol. II, p. 619, 1930.) Retrogression is common in this test at ages beyond 28 days, and may be attributed in part to leaching out of lime. Even the 2x4-in. compression cylinders are not so large but that they are probably weakened somewhat by this same cause. A number of the one-year compression tests on high-limed cements, reported here, gave lower values than the six-month tests, although with the possible exception of one example the differences appear to be within normal testing error. Leaching would be substantially only a surface effect on larger sections and would be practically nonexistent in structures subjected only to atmospheric weathering.

Equations for comparison of cements

The data that have been given in this and the previous articles make it possible to calculate roughly both the heat and the strength that a cement composition will develop under the test conditions. Figures have already been reported that are suitable for calculating the heat evolution. Analogous ones were not previously determined for the strength because it was felt that the precision of the data did not warrant it. However, in order to examine more fully into the significance of the data, equations have now been set up. These are not to be considered as in any sense suitable for the close prediction of individual strengths, but rather as giving in mathematical form a first approximation to the relative behavior within the group. It should further be noted that, under other conditions of test, both the heat and the strength figures obtained by such calculations will in general vary considerably from the actual. All that is implied in the setting up of these equations is that a basis exists for first approximation to relative behavior, under many conditions of usage. In accord with this it is not believed to be of importance that the heat evolution and strength development were not both determined at the same curing temperature. If their individual relationships with composition hold for relative purposes over the range of temperature between the two sets of data, then a relationship established between these properties will have the same validity.

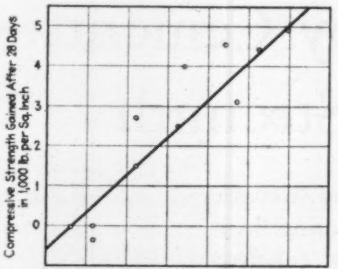


Fig. 2—Correlation between compressive strength gained between 28 days and one year and the dicalcium silicate content of the clinker.

For calculating the strength in terms of composition the approximate straight-line relationship between strength and tricalcium silicate content, exhibited in the previous article, was utilized for the ages of 3, 7 and 28 days. For the three-, six- and twelve-month strength equations there was added to the 28-day equation a further part derived from the approximate straight-line relationship between the increase in strength beyond 28 days and the dicalcium silicate content, of which Fig. 2 of this article is typical. Finally, since the percentages of compounds used in setting up these relationships were based on clinker weight, they were converted to a cement basis for the sake of greater clarity (the difference being occasioned by the gypsum in cement). Only the compressive strength was used in these calculations, and the study is based entirely upon it, as being the more important strength figure for present purposes, and the more reliable one for prediction, particularly at the later ages. The following are the expressions thus obtained:

Age	Compressive Strength, Lb. per Sq.In.
3 days..........	$60 \times \% \, 3CaO.SiO_2 - 600$
7 days..........	$100 \times \% \, 3CaO.SiO_2 - 1550$
28 days..........	$100 \times \% \, 3CaO.SiO_2$
3 mos..........	$100 \times \% \, 3CaO.SiO_2 + 55 \times \% \, 2CaO.SiO_2 - 600$
6 mos..........	$100 \times \% \, 3CaO.SiO_2 + 70 \times \% \, 2CaO.SiO_2$
1 year..........	$100 \times \% \, 3CaO.SiO_2 + 97 \times \% \, 2CaO.SiO_2 - 600$

For the heat equations the results of the least-square analyses might have been used. However, the relationship between the heat evolution and the function: per cent $3CaO.SiO_2 + 2.1 \times$ per cent $3CaO.Al_2O_3$ presented a much simpler basis, quite accurate enough for comparison with the strength data. Accordingly the equations were derived from plots such as Fig. 1. Converted to the cement basis, the expressions are as follows:

Age	Heat Evolution in Cal. Per Gm.	
3 days..........	$19 + 0.77$	$(\% \, 3CaO.SiO_2 + 2.1 \times \% \, 3CaO.Al_2O_3)$
7 days..........	$22 + 0.85$	
28 days..........	$40 + 0.75$	
3 mos..........	$52 + 0.65$	
6 mos..........	$52 + 0.71$	
1 year..........	$53 + 0.75$	

Choice of cement for massive concrete

These expressions for heat evolution and for strength development now provide a basis for study which is believed to add somewhat to that which was evident in the diagrams alone.

The strength is the more fundamental quantity, without an adequate development of which the concrete would be unsuitable whatever the heat evolution. In practice, therefore, the cement composition must first be capable of developing the required strength when it is needed, and only if that is assured can considerations of low heat evolution for the prevention of undesirable stresses be introduced. The situation is somewhat modified by the fact that the strength of a given cement can be increased within limits by decreasing the water-cement ratio—a change, moreover, that would be expected to decrease the heat evolution somewhat because of the smaller proportion of water available for chemical reaction. However, practical considerations limit the degree to which the water-cement ratio may be changed. Again, it is often true, particularly in massive structures, that the early strength can be relatively low provided a sufficiently great strength is eventually developed. In any event, examination of the strength data alone serves to indicate the compounds that cannot be reduced unreservedly without endangering the strength.

If the desired strength must be obtained at 28 days or less, the equations indicate that there will be a minimum percentage of tricalcium silicate below which it will not be advisable to go. At later ages the contribution of dicalcium silicate becomes of significance, and increasingly so with the passage of time, as shown by the increase in the coefficient by which the per cent of this compound is multiplied. At the age of one year the coefficients of the two silicates are so nearly equal that, if it were only the strength at this age that had importance, the lower limit could be determined simply in terms of the sum of these two compounds. With more finely ground cements there is reason to believe that the dicalcium silicate produces its effect somewhat earlier.

Provided the strength is adequate, other things being equal, the lower the heat evolution the more desirable the cement for massive work, from which the dissipation of the heat takes place slowly. A large heat evolution results in a pronounced temperature rise, which is objectionable because it induces subsequent stresses, and promotes the development of cracks. The equations show that the heat evolution is expressible in terms solely of the function: per cent $3CaO.SiO_2 + 2.1$ times per cent $3CaO.Al_2O_3$ at all ages investigated, and increases as it increases. This function should, therefore, be kept low. The equations also indicate that even should the function be zero, there would still be some heat evolution. Furthermore, the extent to which the function can be reduced is limited by the fact that the tricalcium silicate, which appears in it, is the prime strength-producing constituent at early ages. It may be reduced most in those cases in which the strength is not very important until the later ages, for at such ages the dicalcium silicate makes a large contribution.

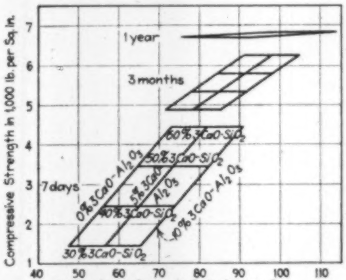


Fig. 3—Calculated relationship between the strength development and heat evolution of cement compositions, the sum of whose two calcium silicates has been held constant at 75 per cent of the whole.

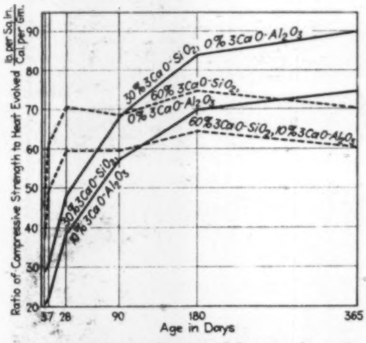


Fig. 4—Calculated strength-heat ratio and its change with time for cement compositions, the sum of whose two calcium silicates has been held constant at 75 per cent of the whole.

It is more effective to lower the heat function by lowering the tricalcium aluminate than by lowering the tricalcium silicate, because the former makes double the contribution to the heat equation, and yet none to the strength. Thus, if the equations held strictly, the heat evolution might be dropped considerably, with no decrease in strength, simply by diminishing the tricalcium aluminate while maintaining the tricalcium silicate constant. On the other hand, it may not be desirable to eliminate entirely the tricalcium aluminate because of possible adverse effect upon the setting time and because, due to difficulty in achieving exact control during manufacture, the alumina to iron oxide ratio would be apt to drop too low. This would probably result in the formation of some dicalcium ferrite, $2CaO.Fe_2O_3$, whose properties in cement are not well known but appear to be undesirable. (*Concrete,* Mill Sect., May, 1932, p. 66.)

Even when the tricalcium silicate is severely reduced, in order to lower the heat evolution markedly below that which is attained simply by lowering the tricalcium aluminate content, the total silicates need not be reduced. Even if they are reduced somewhat, they will still remain at a high figure, thus assuring a good ultimate strength because of the increasing effect of the dicalcium silicate at the later ages, which gives some promise of surpassing that of the tricalcium silicate after the first year. Accordingly, although the early strength may have been reduced to the barest possible minimum in order to secure a very low temperature rise, assurance is had that the strength will continue to increase for a long time.

Graphical representations

The relationships that have just been drawn are illustrated in Fig. 3, in which the equations have been used to plot strength against heat. The strengths were calculated assuming the sum of the percentages of the two silicates constant at 75. A range of compositions having varying amounts of tricalcium silicate and tricalcium aluminate are represented at the ages of seven days, three months and one year.

Attention to the seven-day plot shows how, with decreasing heat evolution, the strength decreases most when only the tricalcium silicate is dropped, and does not decrease at all when the drop in heat evolution is brought about entirely by decrease in the tricalcium aluminate. The three-month plot shows by its lesser slope that at this age the decrease in heat evolution by decrease in tricalcium silicate causes less drop in strength. The one-year plot demonstrates in a striking way that there remain practically no differences in strength, although the changes in compositions still effect marked differences in heat evolution.

Another way of depicting the change with time of the relationship between strength and heat has been employed in Fig. 4. In this the ratio of strength to heat, calculated from the equations, is plotted directly against time, employing the same assumption as before, a constant total of 75 per cent for the two silicates. Curves are shown for the limiting compositions represented in Fig. 3. The low tricalcium silicate compositions start out with a low value of this ratio, but eventually they outstrip considerably the corresponding compositions with higher tricalcium silicate.

Summary and conclusions

One-year data on the heat evolution and strength development of cements of widely varied composition, whose showing at 3, 7 and 28 days, and 3 and 6 months was recorded in previous articles, have been reported, and a joint study has been made of all of the heat and strength data.

The following conclusions are drawn as applicable to the conditions maintained in the experiments:

1. By decreasing the tricalcium aluminate content some decrease in heat evolution at all the test ages can be effected without materially decreasing the strength devolpment at any of these ages.
2. To effect greater decreases in heat evolution, by changes in composition, the tricalcium silicate content must also be lowered, thus lowering the early strength; but this need not, and in general will not, lower the one-year strength. Indeed it appears probable that the eventual strength may be increased.
3. The ratio of strength devolpment to heat evolution, as determined for the higher heat-evolving cements, rises during the first month and then attains a fairly constant value.
4. As determined for the lower heat-evolving cements, the strength-heat ratio has a lower value at the early test ages, but continues to rise throughout the year, at the end of which time it is greater than for the higher heat-evolving cements.

Detroit Installs New Type of Safety Zone

By Allan P. Gardner
Detroit, Mich.

A NEW type of safety zone, said to be absolutely safe for its occupants, has been installed on Grand River Ave., Detroit, Mich., by the Wayne County road commission. Its approach is similar to the prow of a boat and, it is claimed, it will divert any automobile from the zone's occupants. The over-all length of these zones is 71 ft. The platforms are 60 ft. long and 5 ft. wide.

The platforms are of precast reinforced-concrete slabs, made in the shops of the Wayne County road commission. They are 3.5 in. thick. All formwork was fabricated and set up on the job. Steel was purchased and fabricated ready to set up.

This method of handling the construction of the zones enables the commission to install them in a very short time, with little inconvenience to traffic. There is a total of 8 cu.yd. of concrete in each structure. They were built at a cost of about $770 each, although it is estimated that later this cost can be reduced to about $600. The first ones installed involved numerous changes and delays in construction.

Roller-Compacted Pavement Shows Economy

Ten-mile stretch of alternately rolled and normally finished sections indicates reduced cost through rolling and no loss of quality and appearance

By **Geo. W. Langley, Jr.**
Engineer in Charge for the Wisconsin Highway Department, Sheboygan, Wis.

COMPACTING concrete in pavement by the use of an ordinary road roller has been one of the most interesting recent developments in road construction. One of these experiments was carried on, under the writer's supervision, in Sheboygan County, Wis., during the season of 1932, and the results obtained indicate advantages that warrant attention.

Wisconsin state-aid project No. 2094, 10 miles long, to be surfaced with concrete 20 ft. wide, was selected in the spring of 1932 for the experiment.

Special specifications

Special provisions, supplementing the regular Wisconsin highway commission specifications, were drawn to cover as closely as possible the scope of the experimentation. The important items in these special provisions were as follows:

> The concrete shall be designed by the engineer to produce a transverse strength of 700 lb. per sq.in. in 28 days, with the mix controlled so as to produce a workable concrete of maximum density capable of being placed and finished without resulting in honeycombs or voids in the finished pavement. The maximum amount of net water per sack of cement shall be 6 gal.
>
> The maximum amount of water per cubic yard of concrete shall be 30 gal., and the minimum amount of new water per cubic yard of concrete shall be 25 gal.
>
> It is the intention to finish, by rolling with a 5-ton roller, six pieces of pavement, each approximately 1,200 ft. long, but in no case exceeding 1,500 ft. in length. Each section of rolled concrete is to be followed by an approximately equal amount of pavement finished in the usual manner. (Containing the same cement per cubic yard as the previous rolled concrete.)
>
> Two finishing machines of the type specified in the regular specifications shall be operated on all of this project.
>
> The roller used on the rolled concrete shall be an approved, motor-driven, tandem-wheeled type and shall weigh not less than 190 nor more than 215 lb. per linear inch of drive roll width.
>
> On the rolled sections of concrete one finishing machine shall be operated ahead of the roller with the screeds set to the proper height (to be determined by the engineer in charge) properly to strike the concrete off, so that after the roller has been operated over the concrete to the extent necessary to bring about full compaction, the second finishing machine can strike off and bring the slab to finished grade elevation with a minimum of effort.

Materials and proportions

Regular Wisconsin highway commission specifications provide for proportioning the aggregates into the batch in four grades: fine aggregates, coarse aggregates ¼ to ¾ in., coarse aggregate ¾ to 1½ in. and coarse aggregate 1½ to 2½ in.

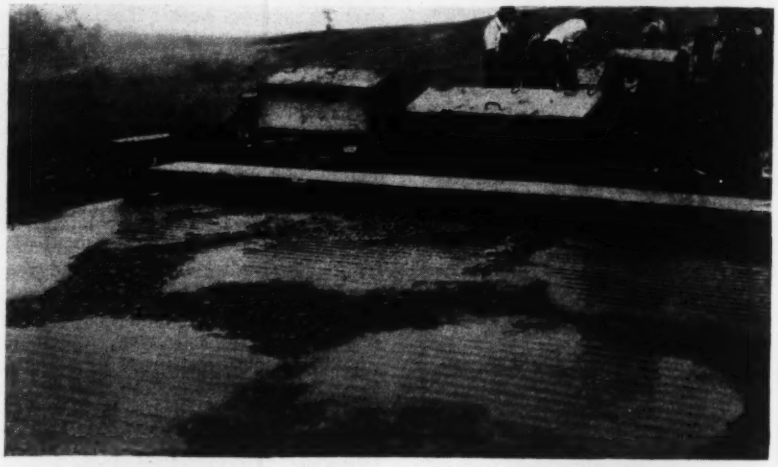
The project was advertised for bids, among the units being 107,949 sq.yd. of portland cement concrete pavement, exclusive of cement, and 16,000 sq.yd. of rolled concrete pavement, exclusive of cement. Paul C. Kroeck, Inc., of Superior, Wis., was awarded the contract. The bid of this company per square yard of standard concrete pavement was 57 and 61c. a square yard on the rolled concrete.

The writer, as engineer in charge employed by the state and county highway departments, was instructed to have the contractor proceed with the work, using the special specifications quoted as a general guide but keeping the work on as practical a basis as possible.

The contractor was not required to furnish any added equipment other than the roller, it being deemed inadvisable to make any material expenditure for equipment until it could be determined just what added equipment might be used to advantage.

It was determined to roll concrete one day (about 1,200 ft.) with each of the following cement contents: 3½, 4, 4½, 5 and 6 bags; each day of rolled concrete was to be followed with a day of concrete produced with the same cement content as the previous day of rolled concrete but finished in the ordinary manner.

The mix for the first day's operation on rolled concrete contained 3½ bags of cement. Of a cubic yard 90 per cent was coarse aggregate containing 35 per cent voids; hence 15.795 cu.ft. out of the 27 cu.ft. of concrete was coarse aggregate, and the rest (11.205 cu.ft.) was mortar. As 3½ bags of cement was used, the absolute volume of which was 1.697 cu.ft., the ratio of cement in the mortar was 15.1 per cent.



Appearance of concrete as struck off ¾ in. high by first finishing machine preparatory to compaction by rolling.

Methods and performance

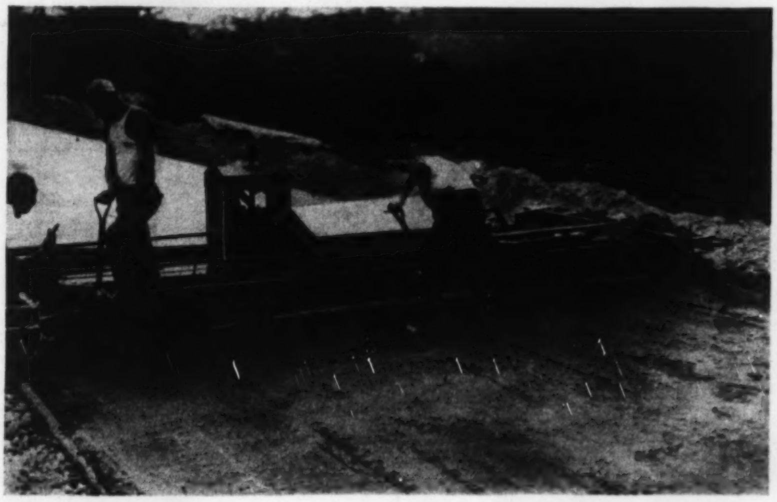
As could be expected, some difficulties developed and had to be contended with on the first day's operation. It took some time to determine how high above the finished grade to strike off the concrete with the first finishing machine; also mechanical trouble developed in the roller, and other little difficulties were encountered. At noon the mechanical trouble with the motor of the roller had developed to a point where it was deemed advisable to discontinue rolling for the day and to start in at noon the next day so as to obtain a full day's work. About 450 ft. of pavement was laid in the six hours worked before noon.

Repairs were made during the afternoon and the forenoon of the next day, and work on the rolled concrete was resumed at noon, slightly more than 700 ft. being laid during the six hours of the afternoon. (Two shifts of six hours each were employed throughout this project.) During this day's work it was determined that it was necessary to strike the concrete off with the front finishing machine from ⅝ to ¾ in. above finished grade, and but little trouble was encountered with this detail on the rest of the project.

Rolling concrete pavement in Wisconsin. View shows condition of concrete after rolling and before use of final finishing machine.

It was noted that due to the extreme harshness of the mix there was a noticeable segregation of the large stone along the outside edge of the batches when deposited on the subgrade, and changes were made in the percentage of coarse aggregate in the batch on the rest of the project in an attempt to overcome this difficulty. On the whole, the day's work demonstrated that concrete could be compacted with a roller to the extent indicated and finished afterwards to a surface that was almost, if not quite, equal to that of the ordinary finished pavement.

On the following day concrete was laid containing 3½ bags of cement per cubic yard. In this mix ¾ cu.yd. of coarse aggregate, with a void content of 35 per cent, was used per cubic yard of concrete; and consequently of the 27 cu.ft. of concrete 13.16 cu.ft. was the absolute volume of coarse aggregate and 13.84 cu.ft. was mortar, cement being 12.2 per cent of the mortar.



Second finishing machine shaving down rolled concrete and giving final machine finish.

The rolled portion of the project was completed as scheduled with no difficulty. Changes were made from time to time in the proportioning of the aggregates, the method of operation of the roller and in placing the concrete in a successful endeavor to better the results obtained.

The maximum day's work was 1,560 lin.ft. in twelve hours. A total of 7,537 lin.ft., or 16,733 sq.yd., of rolled concrete was laid, the average per hour being 104.7 lin.ft., or 232.2 sq.yd.

Cores were cut from the rolled concrete of each day and from the concrete with the same cement content poured the following day. A considerable number of these cores were broken at an age of 28 days, and the rest will be broken at an age of six months.

The records from this project are now being checked and compiled in report form, so that the mix data in the accompanying tabulation are approximate and subject to slight corrections.

Indicated conclusions

It is easy to see from these data that considerable added strength is obtained in the concrete with the lower cement contents from the compacting, and that it is quite possible to produce pavement of desirable strength with a considerable reduction in cost per square yard by the use of a roller for compaction.

The rolled portion was completed in August, and a very recent survey (January, 1933) of that portion showed

COMPARATIVE COMPOSITIONS AND STRENGTHS OF CONCRETE IN ROLLED PAVEMENT AND PAVEMENT FINISHED IN ORDINARY MANNER

Bags of Cement Per Cu.Yd. Concrete	Cu.Ft. Agg. Per Cu.Yd. Concrete	Cu.Ft. Abs. Vol. Agg. Per Cu.Yd. Concrete	Cu.Ft. Mortar Per Cu.Yd. Concrete	Per Cent Cement in Mortar	No. Cores Broken	Compressive Strength, Per Sq. In. at 28 Days
ROLLED CONCRETE						
3.5	24.3	15.795	11.205	15.1	15	3,502
4	23.67	15.44	11.56	16.8	10	3,497
4.5	23.22	15.09	11.91	18.3	15	4,199
5	22.95	14.92	12.08	20.1	10	4,025
5.5	22.41	14.56	12.44	21.4	10	4,450
6	23.22	15.09	11.91	24.4	12	4,314
ORDINARY CONCRETE						
3.5	20.25	13.16	13.84	12.2	15	2,857
4	20.25	13.16	13.84	14	10	3,031
4.5	20.52	13.34	13.66	15.9	10	3,814
5	20.52	13.34	13.66	17.7	10	4,191
5.5	20.52	13.34	13.66	19.5	10	4,363
6	20.52	13.34	13.66	21.3	10	4,943

one transverse crack in the entire length. Without the records of the starting and ending points of the rolled sections it is impossible to locate them, as the appearance of the slab is exactly the same as that of the rest of the project.

Experience indicated that certain changes in equipment would increase production to a considerable extent. A plane similar to a subgrade plane, traveling on the forms and attached to the mixer by cables sufficiently long to permit depositing concrete ahead of the plane, with the blade of the plane adjustable so that it could be set so as to strike off the concrete at the proper height above finished grade, would eliminate the need of the forward finishing machine.

Experience also indicated that the roller should be operated slowly to get the best results, and as more power is required than is required on ordinary road rolling, the machine should be over-powered. If a high rate of production were to be maintained, it might even be advisable to use two rollers. The roller should weigh not less than 5 tons, and the writer believes that better results would be obtained with one weighing 7 or 8 tons.

There are manufactured rollers with crawler tracks on the traction end and a heavy roller wheel on the other end of the machine, and it is probable that one of these would better accomplish the results desired than does the ordinary tandem-roller. With further experience some other alterations in equipment might be found advisable, but any such changes would doubtless be minor and inexpensive.

After experience on this experimental project and after study of the results obtained, both as to economies and quality of production, we are rather strongly of the opinion that there is a future for this method.

This project was carried on in cooperation with and under the observation of engineers of the division of management, U. S. Bureau of Public Roads, and much of the success of the experiment is due to their very hearty cooperation.

Dust-Explosion Tests Suggest New Building Practices

Reliance on breaking of windows is not adequate to prevent structural damage—Vents needed near source of explosion to prevent secondary explosions

IN ORDER to obtain accurate data on the venting area required for various explosive dusts and on the efficiency of various types of vents, an experimental structure in which the venting of dust explosions can be studied has been installed at the Arlington, Va., experimental station of the U. S. Department of Agriculture. The structure contains a room, a gallery and a tower, and fixed glass windows provide a factor of safety by breaking when the venting area is not sufficient to prevent excessive pressures. Dust is sprayed into the structure, and ignition is produced by an electric heater coil. Explosion pressures are recorded by rubber diaphragm manometers installed at appropriate points in the structure, to record pressures up to 800 lb. per sq.ft. A report of some of the tests will be published in the April *Quarterly* of the National Fire Protection Association by Hylton R. Brown and Richard L. Hanson, of the U. S. Department of Agriculture. The following is abstracted from that report.

Assuming that the breaking of glass indicates the pressure at which structural damage would occur (there are numerous instances in which standard factory glass has withstood pressures of more than 300 lb. per sq.ft.), series of tests were carried out to determine: (1) venting area per unit of volume necessary to prevent structural damage; (2) effect of location and distribution of vents; (3) effect of differences in size and type of ignition; (4) reduction of pressure due to increase in venting area; (5) effect of outside glazing; and (6) effect of scoring glass to reduce the breaking strength.

Venting area necessary

Using the room portion of the experimental structure as the scene of the explosion, it was concluded that to provide satisfactory venting for an explosion of starch dust in a cube-shaped or approximately square room of small size, 3 sq.ft. of vent area for each 100 cu.ft. of volume would be necessary. With grain dust it was indicated that 1.25 sq.ft. of vent should be provided for each 100 cu.ft. of volume. The results obtained with sugar, wood, flour, sulphur, cork, powdered milk, soap powder, wood charcoal and similar products indicated that the venting necessary for these dusts ranges between the requirements for starch and grain dust.

When the tests were extended to include the gallery and tower of the experimental structure, the results indicated very definitely that the shape of the room is an important factor to consider. In the gallery, which is 2½x2½x20 ft., explosions produced a gun-barrel effect with rapidly increasing pressures, and glass along the side of the gallery was broken before these pressures could be released through the openings at the end. Similar results were found in the tower, which is comparable to small-diameter bins, showing that venting at the top only would not be satisfactory.

Location of vents

One or two large vents were more effective than several smaller ones totaling the same area. In using the gallery as the scene of explosion it was shown that vents at the opposite end from the ignition are inadequate protection, even though their area may seem ample. On the other hand, a vent close to the ignition source dissipated the pressure rapidly. The difficulty in making these

An explosion of dust in the experimental structure when proper venting facilities prevented structural damage.

results practical is that the exact point of ignition in an industrial plant explosion is not predetermined. When the venting was distributed along the gallery, the amount of safe opening corresponded very closely to that required for the room tests. In other words, the advantage of using distributed vents is indicated.

If any elongated structure is to be protected against dust explosions, whether it be tower, gallery, or L-shaped building, the structure should be sectioned or zoned into cubical units and each of these units vented separately. Vents should be in the amount recommended for the particular dust and should be located in the roof or outer wall inclosing the cubical unit or zone being protected.

Size and type of ignition

The size and type of ignition is responsible for many of the differences noted in dust-explosion tests. Explosions in the gallery and tower occurred much more quickly, and the pressure rose much more rapidly when ignition occurred from a primary explosion in the adjoining room than when the coil alone was used as the source of ignition. This difference is believed to be due to the fact that the flash from the primary ignition in the room, when partly vented through a small opening into the gallery, took the form of a long flame, which ignited the dust cloud at about the same time throughout its length, while the coil produced an ignition at only one point. Test results indicated clearly the added difficulty encountered in trying to vent a secondary explosion, and emphasized the advantage of providing sufficient openings at all points in the structure to vent properly any primary explosion at the origin. By such means the secondary explosion may be wholly prevented.

The venting area per unit of volume recommended is believed to be the minimum that should be used to provide against structural damage. Where additional protection is desired, extra vents should be provided. The tests showed a very definite relation between area of venting and pressure drop.

Outside glazing

In some of the tests steel sash was applied from the outside so that it could be more easily blown out. When clips alone were used to hold the glass in, the average pressure required to remove the glass was about 50 lb. per sq.ft. Using plastic putty, a pressure of about 100 lb. per sq.ft. was required. Using commercial putty and four clips per pane, 200 lb. per sq.ft. of pressure was required. Probably greater pressures would have been required if the putty had been allowed to age longer. The tests indicate that outside glazing with plastic putty has certain advantages worth considering in providing venting area.

Some panes of glass were scored or partly cut in such a way that comparatively low pressures would fracture them. The tests indicated that this method had some merit and that such cuts permit glass to be blown out at one-half to one-third the pressure normally required to break it. Such scoring of glass is not recommended as a substitute for movable vents, but rather as additional protection where large areas of fixed glass are used in addition to the recommended amount of vent.

Summary

The series of studies has not been completed, and only two dusts have been used to any extent; but it is felt that the results obtained are sufficiently definite to indicate that:

1. It is possible to vent dust explosions without causing structural damage.
2. Fixed glass offers too much resistance to permit dependence upon it alone for the release of explosion pressures without structural damage.
3. Many types of venting equipment, hinged doors, windows and panels may be satisfactorily used to release explosion pressures, provided sufficient venting area is available.
4. Vents near the source of ignition are more effective than those located some distance away.
5. The venting area required varies for different dusts.
6. Secondary explosions are more difficult to vent than primary explosions.
7. A definite reduction in pressure results as the venting area is increased.
8. Pressures may be released by lowering the resistance of fixed glass by means of outside glazing or by scoring.

Novel Bridge Renewal on an Indian Railway

New trusses hauled out by grip-rail locomotive on 3-ft. track cantilevered outside old spans

A NOVEL method of placing bridge trusses was developed in the replacement of an old single-track bridge by a double-track structure across the Rupnarain River, on the Bengal-Nagpur Railway, India. The old bridge, consisting of seven 300-ft. spans and two 200-ft. flanking spans, had been an unsatisfactory link in a double-track main line. Piers for the new bridge are in line with the old piers.

Timber falsework was built alongside the first 300-ft. old span, wide enough for the erection of the new span and extending over a space of 5 ft. left between the adjacent old and new trusses. In this open space was laid a track of 3-ft. gage, which was extended along the full length of the old bridge, being supported by stringers resting on temporary cantilevers attached to the old spans. The twelve trusses for the next six spans were erected successively in the 5-ft. gap mentioned.

As each truss was completed it was transferred from the jacked supports to a pair of trucks and was then hauled out on the cantilevered track by a little electric locomotive of special design. Each truss was 310 ft. long and 42 ft. deep, with a weight of about 220 tons. Such a load on one side of the old spans would have caused undesirable stresses in the trusses and bracing. It was partly equalized therefore by a train of small tank cars moving on a similar cantilevered track on the opposite side of the bridge.

To reduce the moving load, the weight of the electric locomotive was limited to 6 tons. This made it impossible to secure sufficient adhesion to haul 220-ton loads, and recourse was had to the old Fell center-rail system, designed for heavy grades. The engine therefore had four horizontal driving wheels gripping, by spring pressure, a rail laid between the track rails. A vertical pole on the engine carried a cross-arm with contact shoes engaging wires strung outside the old trusses. The engine could haul a truss at a speed of about 35 ft. per minute. To steady the truss during its journey, temporary yokes were attached to the truss posts and engaged a guide girder composed of a pair of I-beams (one with web vertical and the other with web horizontal), carried by brackets on the posts of the old trusses.

On reaching the desired position the truss was shifted to traversing frames on the piers, the water tanks of the counterbalance train being then emptied to relieve the load. Each new outer truss had then to be shifted nearly 20 ft. along the piers, being kept upright during this movement by similar traversing frames running on overhead cantilevers attached to temporary towers on the old spans. The inner trusses had to be moved only a short distance. An electric crane placed the floor system and bracing, the material being delivered on a track of 2-ft. gage.

This method was devised by R. Strick, bridge engineer of the Bengal-Nagpur Railway, as being quicker and more economical than erection on falsework or building the spans on shore and floating them into place.

Reappraising the Work and Methods of the Engineering College

Two leaders in technical education discuss the influence of the depression on the school program and curriculum

ECONOMIC EVENTS, which have exerted a powerful influence on the working engineer's activities during the last three years, are affecting also the engineering colleges. Shrinking funds and changes in enrollment have already led to administrative readjustments in a number of institutions, as was brought out in a review of college activities published in our issue of Feb. 2, 1933, p. 170. External factors of change are also becoming discernible as engineers take an increasing part in non-engineering work. The conditions forecast possible modification of the educational programs of the colleges.

Suggestions to this effect, received in the inquiry which developed the data for the review above noted, led the editors to seek the views of several leaders in the field of engineering education. They were asked to outline the influences now operating and their probable effect upon plan and methods of the college. H. S. Rogers, of Oregon State College, and R. A. Seaton, of Kansas State College, discuss these influences and changes in the present article.

Briefly, both discussions indicate that more or less extensive change lies ahead. In the words of Dean Rogers, "It seems inevitable that some adjustments in educational curricula and programs must result." The adjustments may include broadening of the four-year course and specialization of the future technical leaders through post-graduate courses. Such changes obviously are of broad importance to the engineer, involving the structure and growth of the profession as well as the range of individual opportunity.

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Influences and Trends in Engineering Education

By H. S. Rogers
Dean, School of Engineering, Oregon State College, Corvallis, Ore.

THE ECONOMIC and industrial influences acting upon the engineering schools at the present time are so intense and promise to be of such duration that it seems inevitable that some adjustments in engineering curricula and programs must result. The predominant influences of industry for change in engineering education seem at present to be amplified in their pressure by the economic conditions confronting the schools and the student bodies; the influences against the readjustments seem, on the other hand, to be losing some of their weight.

The problem of best fitting the engineering student of the future for his work and responsibilities in life and for the fullest development of his possibilities for service is one which still in a large part is surrounded by traditional limitations of time and academic conditions. Within the field of these limitations, however, the influence of the changes in the avenues of promotion in industry, the influence of restricted budgets in the schools, and the influence of the general economic conditions upon student bodies are immediately apparent and, it seems, will increase to some extent in magnitude with the progress of time. Any attempt to predict the effect of the changes in industry upon the programs of engineering schools is, of course, limited by the changing and unstable conditions of the immediate period and by the limited data and information at hand.

The influence of industrial evolution

An interpretation of the historical progress in industry and the assumption that the past trend will be continued with the return of normal times make it possible to estimate the factors that will in the near future bring influence upon our educational program, and to compare and correlate such factors with the forces of the immediate conditions. Without attempting any long explanation in defense of the postulate, we may divide the Industrial Revolution in America into the transportation era (from the early part of the nineteenth century to approximately 1870), the shop-manufacturing era (1870 to 1901), the large-scale production era (1901 to 1920) and the era of research (1920 to date). In these periods the most significant developments in the factors of production have been, respectively, power and materials in the first, machine and manufacturing processes in the second, standardization and scientific management in the third, and research in the last.

With the development of research for the improvement and perfection of the other factors of industry, and with its more or less general adoption by large industry, all fundamental factors of production have been recognized and established. The products resulting from the growth and improvements of these factors, however, can be predicted by no one. The influence of these developments in industry upon the avenues of promotion of the graduates from engineering schools is apparent throughout industrial history and seems to be potentially greater for change at the present time than in recent years.

Large-scale production with its coincident standardization and simplification is reducing relatively the number of routine workers required in technological service. Scientific management coincident with the expansion and consolidation of large industrial corporations is, on the other hand, increasing the need for a trained and skilled management personnel. The standardization and simplification of machine tools, together with a diversification of products, is calling for a high order of skill and ingenuity in the adaptation of production machinery to the manufacture of products. Competition for markets has stimulated research to its highest levels of accomplishment.

Higher training gains value

The resulting pressure of these conditions seems, therefore, to be in the direction of the need for a more highly trained personnel in management, research and advanced design. At the same time there is lessened need for a highly trained technological staff for the routine positions of detailing, drafting, designing and estimating under the program of standardization and simplification. The economic influences acting upon the engineering schools and the young men seeking advancement in engineering and collateral fields seem at the present time to be working in harmony with the conditions governing employment in industry. The decreasing number of entering students and the increasing number of those remaining for graduate study and research will provide fewer men for the routine technological positions and more highly trained men for the work in advanced design and research.

At the approach of the present depression we were rapidly developing a condition under which industry was recognizing the value of advanced work and making it possible for engineering students of a high order of ability to capitalize upon it. It may be expected that this will continue, and furthermore, that those who under existing conditions attend graduate schools because of the restriction in opportunities for employment will amply prove the merits of their advanced preparation. It also seems apparent that some of the stronger schools of business administration, such as Harvard, Wharton, Chicago and Stanford, are attracting numbers of the most able engineering students who are qualified by interests and capacities for management and administration.

A broadened four-year course

The man with the normal four-year training faces a most difficult problem and needs immediately to be prepared by a broader educational program for entrance into a wider range of activities in the fields collateral to engineering. His training in engineering science and technology need not now be as intensive as heretofore because of the competition of graduate students who will receive priority in the selection for those positions requiring advanced mastery of engineering principles. His preparation in collateral fields of engineering requires a knowledge of business and administration, however, and needs to be broader than provided under present curricula.

The compounding of all these forces, therefore, seems to be directing the engineering schools toward a program of four years' duration in which a greater emphasis upon the collateral interests of business and management will result in a lesser emphasis upon engineering science and technology. This lessening of emphasis upon engineering science and technology in the four-year curriculum will be more than compensated for by graduate training for those who seem especially qualified by interests, capacities and abilities for advanced technical work. It seems that when industry resumes its forward movement and picks up momentum the competition for appointments will emphasize a need for such advanced training, just as the competition for appointments now emphasizes the need for advanced training for the teachers in the public-school systems of some of our larger cities. It seems also apparent that men fundamentally trained in engineering with an inclination toward management can capitalize upon graduate training in those few schools that have developed programs upon the graduate level and are applying the practical and intensive pedagogy of the problem, project and seminar methods.

Difficulties of two kinds

The forces acting against such changes are both financial and academic. The reduced resources of prospective graduate students may limit their number so that, with the resumption of industry, industrial corporations will again find it necessary to carry on training courses for the induction of engineering graduates into advanced design and research. The lag between the declining student numbers and the reduction of the teaching staff, while it releases time and energies for a greater amount of graduate work, at the same time makes unsatisfactory the problem of releasing credit hours in the four-year program of engineering science and technology for other credits in management and administration. This is especially true where such courses are taught outside the engineering-school organization.

One of the greatest obstacles to increasing the breadth of the engineering curricula is the result of the status of courses and the effectiveness of teaching in the average undergraduate school of business administration. No engineer need project himself into the foreground to take the responsibility for criticizing education in business and management when he can find such an authority as L. C. Marshall, former director of economics and business at the University of Chicago, to quote in the following manner: "As matters stand today there is lamentable weakness in the instruction staffs of the collegiate schools of business administration. The actual situation falls far short of the ideal here pictured. If a visiting scholar from Mars were to make the rounds of the nearly 200 colleges and universities which allege that they have instructing staffs in business, you would find the general situation all but incredible."[1] The conditions existing in the courses of instruction in both English and business are not understood and recognized by graduates of former years who advocate a greater amount of such work in engineering curricula. With the progress of time, however, the unsatisfactory characteristics are being corrected and eliminated.

A working adjustment

Until such time as an instruction staff with training and experience is available for integrating the principles and methods of business with the field of engineering science and technology as a preparation for a life career, there will be no extensive substitution of business courses for those in engineering science and technology. A limited number of courses in constructive accounting, principles of economics, management, finance and law may, however, serve the purpose of immediately increasing the scope of engineering curricula in a manner to make it possible for a graduate to find more readily an avenue of approach to experience and advancement in present economic conditions.

An adjustment to meet this immediate condition in the four-year curricula seems in harmony with a program to meet the anticipated condition in industry under a resumed normal status. Such a program has been evolving ever since the development of large-scale production and scientific management. It has recently been given impetus by the recognition and development of research. It may be that the present conditions will give it the final impetus for more general realization. It would provide for the technician and those in collateral fields who look forward to approaching their life careers through post-graduation experience and promotion; it would provide an introduction to the field of management for those whose interests are more particularly in the administrative field of engineering; and it would provide for those whose interests and abilities are strongly technological and professional.

* * *

Adjusting the Technical College to New Demands

By R. A. Seaton

Dean of Engineering, Kansas State College, Manhattan, Kan.

ENGINEERING education is always facing a change, since the field of engineering is not static but is constantly changing, growing and developing. New discoveries in the fundamental sciences, new applications of newly discovered and of long-known phenomena in the field of materials and forces, new industrial developments, and the constantly increasing responsibility of engineers in managerial and administrative work involving human and economic considerations make it necessary constantly to study engineering education to determine whether the best possible training is being given by the colleges for the conditions that will be met by their graduates. Aims and objectives must be scrutinzed, and curricula, courses and methods must be revised frequently to keep pace with new developments in the engineering field.

Changes in the character and preparation of entering students, in the financial support and internal conditions of the colleges themselves, and in the economic and social conditions of the times also have a direct bearing upon the work of the engineering colleges and must be considered in determining upon policies and procedures.

Important recent changes

Engineering educators have been fully alive to the necessity for considering all these factors, and much study has been given to the changing problems of engineering education by individuals, faculties and educational organizations. A notable recent example of such a study is the one made in 1923-29 by the Society for the Promotion of Engineering Education, under the direction of W. E. Wickenden and H. P. Hammond, and reported in publications of that society. Any such study is, however, obsolete to some extent even before it is published. No sooner is the study finished than we are confronted with the question as to what changes should be made in engineering education to meet the changes that have occurred in the conditions affecting the students, the colleges and the engineering field since the data for the study were gathered.

Such changes have been particularly rapid and extensive in the last few years, due in part at least, to the severe and protracted depression. Among the more obvious are:

1. A greatly lowered economic level of the country generally, with money and jobs of all kinds scarce and future conditions very uncertain.
2. A general slump in industry, which has resulted in a great decrease in the demand for engineering graduates and considerable unemployment of engineers who held good positions.
3. Greatly decreased financial support for most colleges, with further decreases in prospect.
4. Considerable decrease in enrollment in the lower classes in engineering colleges, with little or no change in the enrollment in upper classes and in the number of students being graduated.
5. Greatly increased enrollment in graduate engineering courses.
6. A considerable increase in the number of transfer students from junior and liberal-arts colleges to engineering colleges.
7. Development of legal restrictions upon the practice of engineering, with the creation of state registration and examining boards in many states.
8. Increased interest of the professional engineering societies in engineering education and in the progress and development of engineering graduates.

No need for revolutionary revisions

What changes in engineering education should be made to meet these changes, and perhaps others that are not so obvious? Should they be revolutionary or evolutionary, radical or moderate?

The writer can see no need for revolutionary changes in the character of engineering education. Adjustments to the changed conditions are certainly necessary, but in making these adjustments great care should be taken not to lose the sound fundamental character of engineering training which has led to its rapid and extensive development during the past generation and which has been reflected in the enormous industrial development of the country during this period. Most of the conclusions and recommendations of the board of investigation and coordination of the Society for the Promotion of Engineering Education in the study referred to above are believed to be still valid, notwithstanding the changed conditions; and engineering educators will do well, in their consideration of plans for changes in policies and procedures, to keep these recommendations and conclusions constantly in mind.

Certainly one of the changes that must be made immediately in many engineering colleges is a considerable further reduction in expenditures on account of the decreased financial support. Further salary and staff reductions and curtailment of operation and maintenance expenditures are probably inevitable. Some reduction in salaries is probably warranted in consideration of the general economic situation, but this should not go too far. Salaries of engineering teachers are not high, judged even by present standards, and they have been far too low in recent years and will be far too low again when normal economic conditions return. A reduction in the number of staff members without a corresponding reduction in the number of classes to be taught requires heavier teaching schedules, already heavy in most engineering colleges, and allows engineering teachers less time and opportunity for research and other forms of so-called productive scholarship. Curtailment of research is particularly objectionable with the present great increase in graduate study in which research plays such an important part.

Doubtless several colleges with small engineering enrollments will find it advisable to discontinue engineering instruction altogether, as a few have already done recently. Others may reduce their four-year engineering curricula to two-year pre-engineering curricula, or two-year terminal curricula of the technical institute type. Many others, including some of the larger colleges, will probably eliminate certain specialized curricula and courses that have small enrollments and are therefore relatively expensive to maintain. In some cases it may be possible to reduce the number of classes to be taught by decreasing the differentiation of the several curricula and by cutting down the number of elective or optional courses available. Some institutions may find it practicable to reduce enrollments either by setting arbitrary limits or by providing highly selective admission requirements. Generally such a procedure has not been considered permissible in state-supported institutions.

Meaning of enrollment changes

The changes in the character of the enrollment in engineering colleges are believed to be significant. In recent years there has been a rapid and extensive development of junior colleges in many sections of this country. Many students who wish to prepare for an engineering career are now spending one or two years in these junior colleges or in liberal-arts colleges, where they can live at home with little expenditure of money. A considerable part of the decrease in enrollment in the freshman and sophomore classes of engineering colleges and of the increase in the number of transfer students entering engineering colleges with advanced credit can be attributed to this fact. If such transfer students are not to be handicapped in their engineering training, these junior and liberal-arts colleges must provide adequate pre-engineering curricula and must maintain suitable standards, while engineering colleges must adjust their procedures to facilitate admission of such students to advanced standing with a minimum irregularity and loss of credit. Sympathetic cooperation of the engineering college and the junior or liberal-arts colleges is necessary.

It seems probable to the writer that part of the loss in enrollment in the lower classes of engineering colleges may be due to fewer students preparing for engineering careers, and that this will be reflected in the upper-class enrollments and in the number of engineering graduates a few years hence, particularly if the slump in industrial activity continues.

Graduate study increasing

The increase in the graduate enrollment in engineering colleges began before the depression started, and in the judgment of the writer it is a fundamental development of great significance. Without doubt many engineering graduates have remained in colleges for postgraduate courses in the last few years because of their inability to secure suitable positions, hoping to improve their chances of employment and strengthen their preparation for rapid advancement when conditions improve; but much of the development of graduate work is believed to be due to a realization of the fact that the field of engineering has now developed to such an extent and complexity as to give rise to a real need for additional scholastic training for a considerable number of engineering graduates of superior ability. The development is believed to be a wholesome one that will continue after employment conditions again become normal. The increase in the number of students remaining for graduate work may perhaps lead to postponement of some specialization until the post-graduate year and the development of a somewhat broader undergraduate training with more attention to social and economic matters. The increase in graduate work should also give a considerable stimulus to research in engineering colleges and the training of men for research work in industries.

Licensing and professional engineering development

The movement toward licensing of professional engineers will probably not affect engineering education greatly, except perhaps indirectly through restricting the practice of professional engineering to those who have had suitable training and experience, and possibly in raising the standards of some of the weaker schools.

The cooperative movement of the national professional engineering societies, the Society for the Promotion of Engineering Education and the Council of State Boards of Engineering Examiners in the creation of the Engineers Council for Professional Development may have a very profound effect on engineering education, particularly in its post-scholastic stages. It has been well recognized that the few years spent in college can provide only a foundation for an engineering education, and that this must be supplemented by years of experience and study. Much of the specialized knowledge and technique of engineering must be acquired by the young engineer after graduation. Engineering colleges generally have taken little or no part in this phase of engineering education but have left it almost wholly to the initiative of the individual and to industry. A careful study of the possibility of providing help in this stage of the educational process and the provision of suitable facilities for such help may have far-reaching effects. The work of the Council is not yet sufficiently developed to make possible a fair evaluation of the possibilities or a prediction of results, but the field looks inviting.

Simplify, but retain fundamentals

To sum up, engineering education must continue to make adjustments to changing conditions, but these adjustments should be evolutionary rather than radical, retaining the present sound fundamental character of engineering training. Expenditures must be reduced because of reduced financial support of the colleges. Salaries, staffs and operating expenses probably must be reduced in many institutions. Specialized curricula and courses with small enrollments may need to be eliminated, and the differentiation between curricula reduced. Some smaller and weaker institutions may need to discontinue their engineering work entirely or to reduce considerably the amount of such work offered. Better provision should be made where possible to take care of transfer students from junior and liberal-arts colleges. Graduate courses and research work should be strengthened. Perhaps some specialized courses may be shifted from undergraduate to the graduate years, the undergraduate work being broadened to include more social and economic training. The organization of the Engineers Council for Professional Development offers hope for substantial improvement in the post-scholastic phase of engineering education.

Public-Works Construction Needs a Coordinated Program

By Henry H. Wilson
President, Pennsylvania Construction Council, Harrisburg, Pa.

IN THE midst of vast emissions of charity by the federal and state governments, which, if continued indefinitely, threatened to bankrupt the country, the whole nation continues to run around in circles in so far as the determination of a coordinated program is concerned for diverting some of this dole to productive and capital investment channels. As an example, in one of our larger states more than $43,000,000 of state funds and governmental loans has been expended for direct charity within the past twelve months, and there is nothing tangible to show for this expenditure.

R.F.C. loans restricted

Turning to another side of the picture, it can fairly be said that up to the present time the funds provided the Reconstruction Finance Corporation for the stimulation of employment through construction have been almost wholly ineffectual, it being reported that up to January of this year less than $500,000 of this money had been expended upon actual operations. Such a condition is not necessarily a reflection upon the R.F.C. It apears that at least three-fourths of all the applications for construction loans made to that body have been for projects on which repayment was exceedingly doubtful. The officials of the R.F.C. are bound by specific statutes, and no trustees, however appointed, are going to advocate the loan of public money that is not secured

It is believed that any state will make a great error in trying to induce the R.F.C. to embark upon numerous doubtful loans. On the other hand, there are unlimited opportunities if the matter could be approached simultaneously in all the states upon a sound and scientific basis.

In the first place, it would seem inescapable that special legislation must be enacted in all the states to permit the borrowing of money by municipalities from the R.F.C. or some other federal agency for the completion of paving and sewering of streets. This should be done under a provision whereby such loans could be repaid by special assessments properly adjusted and possibly somewhat postponed to avoid undue burdens upon the taxpayers at the present time. It is believed that the federal government can only grant loans for such improvements and for the construction of bridges, municipal buildings, sewage-disposal systems or other public improvements through special authority granted by the state legislatures. Existing laws relating to such facilities may have to be modified to meet the present emergency conditions and to protect the government in making loans.

In connection with this whole subject, it will of course be imperative to safeguard the public by so drawing the laws that they will not afford opportunity for speculation by real-estate promoters. A very strong distinction should be drawn, for instance, between developing unimproved speculative property and doing work in streets of districts that are now built up, but that are without the needed improvements.

Bridge reconstruction

Another field for possible development, through federal loans to states, counties or municipalities, lies in the construction of bridges. The superintendent of public works of one state is reported as saying that there are 5,000 inadequate bridges in that state alone. Other states undoubtedly can furnish comparable numbers.

It would seem possible for the various states to enact laws permitting communities to build bridges and pay for them out of special taxes (or tolls, in the case of bridges over large streams) in order to develop projects that would meet the R.F.C. requirements for security. The construction of a considerable number of relatively small bridges would afford opportunity for distributing a large amount of work throughout the nation.

Real progress in making the R.F.C., or whatever governmental agency may be hereafter set up, a means of definitely stimulating the nation's industry through public construction appears to depend largely upon state and local legislation. It would seem highly desirable to have committees appointed immediately by the governor of each state to study this problem.

At the present time all eyes are turned to Washington, where a construction policy for the nation is now being formulated. There seems to be great diversity of opinion as to just what type of public-construction work should be recommended for immediate adoption to furnish a motivating force against the continually contracting business spiral. Apparently the most practical way to prime the pump of prosperity is through the adoption of a large number of small projects throughout the country, which can be quickly gotten under way. A program of reconstructing thousands of inadequate and small highway bridges throughout the country would be much more effective, for instance, than if further delay were encountered in arranging for larger projects of this sort, requiring many months of preparation and perhaps several years' time in construction.

What the country needs today is the quick provision of a large amount of small work, which will reasonably blanket the land and provide a "spark plug" for our stalled economic machine. It is to be hoped that the present national administration will shortly take the lead in urging upon the states the immediate necessity for the enabling legislation referred to herein, so that the R.F.C. or whatever agency may be substituted therefor can function as a real motivating force for relief.

Strong-Motion Records of Long Beach Earthquake

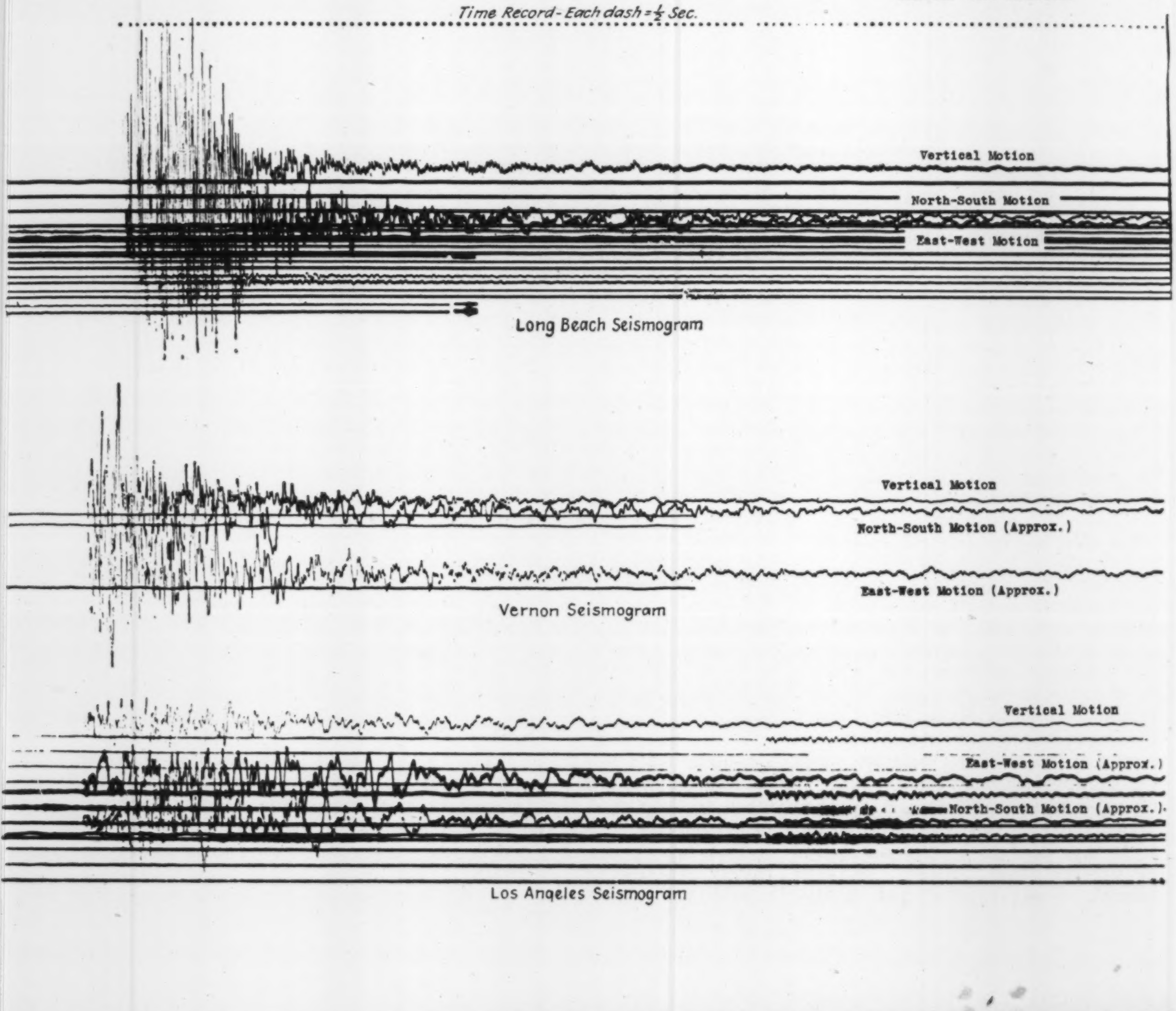
By N. H. Heck

Chief, Division of Terrestial Magnetism and Seismology, Coast and Geodetic Survey, Washington, D. C.

THREE of the accelerographs for recording strong earth motions (*ENR*, Sept. 8, 1932, p. 288), which were installed in various locations in California last summer, produced very satisfactory graphs during the Southern California earthquake of March 10. One of the instruments was in Long Beach, almost on top of the earthquake, and two were in the Los Angeles district, one in the business center and the other in the Vernon industrial section.

With regard to the following brief presentation, it should be understood that the plan has been adopted in the case of all such records to have them carefully studied in Washington, including study of test records, to assure the correctness of the instrumental performance. The conclusions will then be sent to Prof. Perry Byerly, University of California; Prof. Lydik Jacobsen, Stanford University; H. O. Wood, Seismological Research Laboratory, Pasadena, and Prof. R. R. Martel, California Institute of Technology, before the final interpretation is adopted, thus securing the attention of two engi-

Records from three strong-motion accelerometers give an indication of the acceleration produced by the southern California earthquake. At Long Beach this attained the unusual value of 0.3 to 1.0g during the first few seconds of the shock. At Vernon the drum of the instrument passed through about 1⅓ revolutions, while at Los Angeles and Long Beach about 5 revolutions were recorded.



neers and two seismologists who are directly concerned in the problem. It should be understood that these records are to be considered only as the start of a series that is expected to prove very useful in designing to resist earthquakes.

Long Beach Record—This record was obtained almost on top of the fault along which the earthquake occurred, probably centering about 12 miles away beneath the sea, though further study is needed to determine the exact epicenter. From previous information obtained from Japanese records we would expect periods of 0.3 to 2.0 sec. to correspond to the destruction. Actually for the first seven seconds there are vibrations on the order of 0.1 sec., with accelerations from 0.3 to 1.0 *g*, perhaps a little more. Following this there are periods of from 1 to 2 sec. with accelerations not much more than 0.04 *g*. These have superimposed on them small vibrations of shorter periods. It is noteworthy that while the components are somewhat hard to separate, the vertical amplitude of the record is comparable with the horizontal, and the usually adopted 10 to 1 ratio between horizontal and vertical does not appear to be valid. Further, the maximum accelerations adopted in the Cancani scale (from about 0.1 to 0.2 *g*) appear to have little significance. It is the present view of Frank Wenner, of the Bureau of Standards, who designed the accelerometers, and Frank Neumann, seismologist of the Coast and Geodetic Survey, that the short-period high accelerations did not represent the most destructive part of the earthquake, but this view is subject to reconsideration.

Vernon Record—Since this instrument operated through only 1⅓ turns of the drum, the record is less confused than that obtained at Long Beach. The same general conclusions may be deduced though the maximum accelerations were somewhat less. The building containing the instrument was damaged.

Los Angeles Record—The absence of the high accelerations observed at Vernon, only 2 miles away, is a noteworthy characteristic of the Los Angeles graph. It is not certain whether this is due to failure of the instrument to start at the same part of the shock or to the fact that the instrument is on rock, while the others are not. The motions recorded indicate what most of the larger buildings in Los Angeles experienced, since most of them are near by. The rapid disturbance of the right-hand side of the record is due to a street car passing within 20 ft. of the instrument.

A valuable feature of the three records is that the range of distances from the epicenter is on the order of 12, 24 and 26 miles; the effect of distance in lengthening the periods of the waves is evident.

All of these records should be considered as the first returns in the effort to collect information of value to the structural engineer. They do not tell the whole story, since, unfortunately, the displacement meters (although now set up) were not in place at the time of the earthquake, as the installation program is still actively in progress. Also, it would have been very desirable to have had at least in one case a place where there was an instrument in a tall building directly over one in the basement. However, it is generally felt that to have gotten these records so soon after the installation of the instruments was a very worth-while accomplishment.

It should be understood that these records do not represent displacements of the ground.

Letters to the Editor

Suspension-Bridge Rating

Sir—Rating of suspension bridges according to total cable strength, which was suggested in an article appearing in the issue of March 16, is entirely logical. As intimated in that article, total cable strength is determined in large part by the two primary characteristics of all bridge structures: length of main span and load on the bridge as affected by width, type of construction and traffic requirements. The other characteristics of suspension-bridge size enumerated are of secondary importance.

The total length of cable is an indefinite characteristic that indicates the length and slope of suspended side spans or backstays. These lengths are also reflected in the total cable strength. However, the length of side span has only a slight influence on cable stress, and the fact that the maximum slope of the cable (which directly influences the cable stress) is kept fairly constant for all bridges makes the indication of this factor relatively unimportant.

The total cable strength is provided by a set of cables whose number and maximum size are dictated by practical considerations as well as by stress requirements. This number and size are represented in one term, of course, by the total cable strength. The size of cable, nevertheless, is a matter of great interest, and it should be remembered in comparing the size of a twisted-wire strand cable (such as that used on the St. Johns bridge in Portland, Ore.), with a parallel-wire cable that the bulk of the former is considerably greater than that of the latter type of cable for the same total strength. Rating of suspension bridges on the basis of total cable strength does not confuse on this score.

New York, N. Y.,
March 22, 1933.
C. H. Gronquist.

Your Next Job

Sir—I want to thank you for publishing the letter "Keep in Circulation" (*ENR*, Feb. 9, 1933, p. 199). The last paragraph of that letter contains advice invaluable to the thousands of engineers who are unemployed or are nearing unemployment and who have this lesson yet to learn.

Exchange of information is specially important in these days. A group of us in my town are planning an Unemployed Engineers' Convention, to bring together the technically trained men who are facing the stark reality of having to find new means of furnishing subsistence to their families. We can't help one another financially, but we can exchange ideas and buck up the old fighting spirit. I expect to sit in the front row, and I'm going to take along the letter "Keep in Circulation"; it may help the other fellows.

I agree with the writer about the danger of crawling into a hole. My early training equipped me to go back to the land and perhaps eke out a living there; but to do that would lessen the prospect for getting back into the places that I am better fitted to fill. So I intend to keep in circulation. I am still employed, but my good sense tells me to pick out the best landing place I can find before the motor quits entirely.

Chicago, Ill.,
Feb. 18, 1933.
"C.E."

On Keeping in Circulation

Sir—You gave your readers valuable service in publishing the letter "Keep in Circulation" (*ENR*, Feb. 9, 1933, p. 199). The final paragraph of the letter contains advice that is simply invaluable to the many thousands of unemployed engineers, or engineers nearing that state, who have the lesson yet to learn.

I agree with the writer of the letter about the danger of crawling into a hole. As I was raised on a farm, I think I could now go back to the land and manage to exist; but if I did so I would lessen my prospects of getting back later on into the work for which I am better fitted. Therefore I am going to find ways of keeping in circulation, even before the need is at hand. I am still employed, but who knows how long it may last?

Related to this matter of circulating is an idea that was tried in our town a few days ago. We held an "unemployment meeting" of technically trained men who faced the bitter prospect of finding a new way to earn an honest living for their families. Of course we could not help one another financially, but we exchanged ideas and in addition strengthened each other's fighting spirit. A good number of helpful and stimulative ideas were brought to the front in the meeting. There are to be other meetings of the same kind.

March 16, 1933.
Middle-Aged.

Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A. Bowers, J. I. Ballard.

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Rolled Concrete Practicable

CONCRETE is the last of the important road-surfacing materials to be compacted by rolling. A successfully rolled concrete road is described in this issue. The new method is the direct outcome of the trend of practice toward the use of dry concrete for pavement. Without perhaps being actually the first exploratory work, the experiment of the Wisconsin highway engineers is in large measure pioneering in both the use of the power roller and in the use of dry concrete. The results indicate that a new field of development is in sight. In both quality and cost the rolled road slab shows at least equality and probably superiority to pavements laid down by other methods.

Housing Gets Another Chance

LAST WEEK the R.F.C. granted its second housing loan, this time for a project in the slum district of New York's lower east side. May it soon be translated into wages! And may the uninspiring spectacle of real estate opposition aided and abetted by high municipal officers not be encountered as it was on the ill-fated Hillside Housing Corp. loan in the Bronx! Fortunately, Fred F. French's Knickerbocker Village is slum clearance in the extreme, which eliminates the principal objection that was raised against the Bronx loan. It is said that men can be put to work by May 1, and that eventually 2,000 field jobs and 8,000 factory jobs will result from the work. This is what counts at present. Without reflecting on the social and economic importance of the development, which are of first order, employment relief is its most important characteristic.

High Earthquake Accelerations

IF THE FIRST records made by the strong-motion accelerometers during the Long Beach earthquake are correct, earthquake design methods are due for a careful re-study. This was one of the results which it was hoped the installation of the instruments might bring about. For 7 or 8 seconds at the beginning of the quake on March 10 accelerations on the order of 0.3 to 1.0 g were recorded, values that are from three to ten times the seismic coefficient of 0.1 g that has been assumed to be adequate in good designing. Obviously, the records do not mean that well-designed buildings were deficient in the ratio of 1 : 3 or 1 : 10, for no such buildings were seriously damaged. What is more likely is that high accelerations, for a short time at least, are not as destructive as had been assumed. Most of the damage at Long Beach is said to have occurred after the first shock, when accelerations were of nominal amount. The small amount of damage from the high accelerations lends credence to the view that the natural period o vibration of a structure and its possible resonance wit the earthquake motion are the important factors. N doubt some significant deductions can be made whe the accelerometer records have been studied further an compared with some of the laboratory test results tha were made on the instruments before their installatio

For a Stronger Profession

FOR SOME TIME thought has been stirring actively in the direction of re-examining the educational programs of technical colleges. Recent papers and addresses by leading teachers have given indication of this, and the discussions of the college problem by H. S. Rogers and R. A. Seaton in this issue supply further evidence. The question is of broad interest, for its essential purpose is to build a stronger profession to meet the requrements of the future. Conditions of practice have been changing for some years; the trend has been unmistakably apparent since the onset of the depression, and now it is necessary to inquire whether modification of the teaching program is in order. Any such adjustment obviously must conform to the conditions of the moment, when reduced educational funds and altered student distribution create special difficulties; but above all it ought to be prophetic of the conditions of ten and twenty years hence, since the teaching of today serves chiefly to build the profession of coming years. If these future demands are found to be in the direction of more extensive training and more flexible equipment of the student, no time should be lost in preparing for them. But we trust that those who determine college methods will at all times give heed to the controlling objective, which is to train engineers rather than merchants, bankers or statemen.

Federal Power Control Extended

THE Federal Power Commission has won a major engagement in its battle for wider control over hydro-electric power development; the U. S. District Court in Virginia has upheld its claim that the Appalacian Electric Power Co. must obtain a standard license for its proposed power development on the New River. This decision was rendered in a case in which the power company, with the support of the state of Virginia, opposed the power commission's demand that it apply for a standard license on the ground that the New River was not navigable at the point where the company proposed to develop power. The commission, on the other hand, demanded the license application on the ground that while the river was not navigable, its waters were so important to navigation upon the Kanawha River as to render it navigable within the meaning of the Water Power Act. The court supported this view.

The district court's finding is of great significance. If upheld by the U. S. Supreme Court, it will greatly extend the scope of activity of the Federal Power Commission and may even result ultimately in the transfer of control over electric utilities from the states to the federal government, much as control of the railways has passed to the Interstate Commerce Commission. More important still, the number of plants which the federal government may take over at the end of their

50-year license period will be greatly increased. In fact, there are few streams in the country that do not flow into a navigable river or become navigable in their lower reaches, and hence interference with their flow, even in the upper sections, might be assumed to have an effect on their navigability. If the principle laid down in the New River case is sustained, the jurisdiction of the Federal Power Commission may well be assumed to extend right up to the power plants built at the dams of storage reservoirs at the headwaters of most of our rivers. Wherever federal control is exercised the authority of the state public utility commission is weakened. Ultimately, as experience with railroad regulation has shown, though both may have control in theory, control passes to the federal body as a practical matter. Such being the case, the New River decision, if sustained, may well mark the beginning of federal control over all future water-power development. It may convert the Water Power Act into the foundation stone of a federal power system.

Relief and Reconstruction

FOLLOWING the financial measures enacted by the national government during the month just closed, the conservation camp act approved last week introduces the important element of relief for human distress. It is a radical measure, opposed to the precedents of our history; yet the undeniable urgency of the need justifies its enactment. A quarter-million idle workers will be taken care of in healthful, useful activity.

The measure is one for relief only. The camp plan makes no contribution to economic reconstruction. Like the other salvage measures that preceded it, the plan is essentially deflationary; it does nothing to check the declining course of productive activity. Temporarily, in fact, it has an added depressive effect through withdrawing funds from scheduled construction and utilizing them for dole purposes.

At the present moment, therefore, reconstruction must begin. The delicate balance of sustaining and depressive forces will fail if the forward movement is not soon initiated. Unfortunately, there is imminent danger that complacency with what has already been accomplished may be the cause of fatal delay. The initial determination to restore and rebuild may get into the doldrums, and cross-currents of opinion may further hinder its advance.

Strongly divergent convictions are tending to influence official thinking on reconstruction measures. One of these is that the now pending farm relief measures, perhaps aided by revival of the brewing industry, will set up new trade and consumer demand to initiate the progressive recovery of production. Another is that spontaneous growth of consumer trade may now be expected and that recovery is the certain result. Still another relies on the resumption of the capital-goods industries in supplying the demand for replacement of worn-out equipment required for present production volume. Differing in their reasoning, those who hold views of this kind agree in the conclusion that nothing more is now needed for industrial recovery beyond hopeful waiting.

But the advocates of aggressive action toward reconstruction are fortunately still in the field. Relying on the reservoir of deferred local public works as the sole available means by which active purchasing power of sufficiently large proportions can be created, they are urging two alternative methods of putting these works under way. One is the liberalization of the Relief Act as proposed two months ago in the dying Congress and the coincident establishment of a new and more progressive directing personnel in the Reconstruction Finance Corporation. The other and more aggressive plan involves the setting up of a federal-aid system through which local public works, under approval and supervision of responsible state boards, would be supported to the extent of half their cost by federal funds. Both proposals are engaging close and sympathetic study, with a view to their adoption as soon as the opposition of the adherents of a waiting policy can be overcome.

Newest of these proposals, the federal-aid plan is supported by a group of intelligent and able men on the basis of thorough study of its effects. Leaders of the Construction League and of the National Committee for Trade Recovery favor it. First among the supporting reasons is the necessity of overcoming the apathy and opposition of local taxpayers to all improvement expenditures, by making public-works construction highly advantageous to them. Under the aid plan the interest charge upon the local community would be low enough to become a negligible budget item when compared with the wealth created and the wage and industry income produced. Only through this inducement, it is urged, can simultaneous resumption of interrupted construction activity throughout the country be brought about and the gain of new industrial and trade activity be distributed among the whole population.

The burden placed on the national treasury by such a plan is an obvious objection. Can the plan be financed? Is it sound? A complete answer has been given by able economists, who state that the federal-aid contribution will be self-liquidating; it will increase the income-tax revenues of the government sufficiently to pay off the full expenditure within a very few years.

What federal aid has accomplished for the creation of a magnificent highway network spreading through all the states is well known. It built a great revenue-producing new utility efficiently and honestly. If local public works are exposed to a like constructive influence every community will be the gainer.

But federal aid had an even more important effect. It brought about the very result needed today if public works are to become the instrument of business recovery: it stimulated an enthusiasm and consistent cooperation on the part of the local governments in a coherent national plan. With the help of an equal degree of enthusiastic cooperation, the billions of dollars of deferred local improvements can now be made the lever for moving business off its dead center. It is on these grounds that the federal-aid proposal makes its claim for support.

At the moment the opposing policies of procrastination and action appear to be at stalemate. The next few weeks are likely to determine the outcome. With an army of more than twelve million idle workers placing a daily greater load on the slowing economic machine, there can be no doubt as to what the decision should be. Every citizen has the opportunity to help in shaping it, by urging the national government to abandon the waiting policy and act to make local public-works employment the agency of general business recovery from the depression.

NEWS OF THE WEEK

Loan Approved for Two Bridges Near Buffalo, N. Y.

A LOAN of $2,800,000 to the Niagara Frontier Bridge Commission for the construction of two bridges connecting Grand Island in the Niagara River with the mainland, was authorized by the Reconstruction Finance Corporation on March 31. The bridges are to open a large area on the island for development and would also provide a new highway route between Buffalo and Niagara Falls reducing the road distance by 4½ miles. The north bridge will be 4,100 ft. long and the south bridge 2,000 ft. Long approaches will be required for each structure and the state of New York will construct six miles of highway on Grand Island to connect them.

George C. Diehl, Buffalo, and Waddell & Hardesty, New York, are consulting engineers for the bridge commission.

Recently the New York State legislature amended the act of 1929 creating the bridge commission in order to make it possible for the commission to apply to the Reconstruction Finance Corporation for a loan to finance construction of the bridges. The act also extended the life of the commission until 1939 or as long thereafter as is necessary to discharge its liabilities. The R.F.C. has agreed to take 4½ per cent bonds of the commission.

Tri-borough bridge, New York

In order to permit the resumption of work on the Tri-borough bridge, New York, connecting the boroughs of Bronx and Manhattan with the borough of Queens on Long Island, a bill has been introduced into the New York State Legislature authorizing the setting up of a bridge authority similar to that set up to build the Catskill and Niagara bridges. Foundation work for the bridge was practically completed when work was shut down by the city on account of a lack of funds.

Forest work in Michigan

The Michigan Committee for Trade Recovery has asked the Reconstruction Finance Corporation to approve its plan for spending $600,000 of welfare funds that ordinarily would go into direct relief for reforestation work, state park improvements and highway construction. The work has been mapped out in county units. Highway construction will be confined to clearing and grading of roads in parks and forest reserves, chiefly to aid in fighting forest fires.

Harbor work at Los Angeles

The Board of Harbor Commissioners of Los Angeles, Calif., plans to apply to the R.F.C. for a loan of $2,000,000 to carry out port development work including a new passenger and cargo terminal at the upper end of the West Basin, construction of landing facilities at Fifth St., extension of the Santa Fe Harbor Belt Line and construction of a new Fish Harbor jetty. The commission also will ask the R.F.C. for $250,000 for repairs to the marine terminal damaged by the earthquake of March 10.

Two loans approved

Loans of $40,000 to Richmond, Ky. for a new gas plant and $15,500 to Roseville, Ohio, for waterworks improvement have been approved by the R.F.C.

The village of Northport, Mich., has applied to the R.F.C. for a loan of $33,000 for a waterworks plant and distribution system, and the county of Chippewa, Mich., has applied for a loan of $27,000 for the construction of a nurses' home as an addition to the Chippewa War Memorial Hospital at Sault Ste. Marie, Mich.

◆

Sale of Bonds to R.F.C. Prohibited

The sale of $645,000 of 6 per cent waterworks revenue bonds to the Reconstruction Finance Corporation by Ogden, Utah, has been stopped by a writ issued by the state supreme court. The supreme court declared the sale unconstitutional on the ground that it would result in the issue of bonds in excess of the legal debt limit of the city.

◆

Charles D. Marx Resigns from R.F.C. Engineering Board

Charles D. Marx who has been chairman of the engineering advisory board of the Reconstruction Finance Corp. since its organization in August, 1932, has resigned in order to return to Stanford University in California where he is professor emeritus of engineering. At the time the engineering advisory board was appointed from a list prepared for the President by American Engineering Council, it was stated that Dr. Marx was President Hoover's personal choice for the head of the advisory board.

◆

Work Development Committee Appointed by Ohio Governor

A work project development committee was appointed recently by the governor of Ohio to make a state-wide survey of needed public work which if undertaken will tend to reduce the need of direct relief. The services of the state highway department, county, municipal and township officials have been enlisted, reports of local work clearing through the division offices of the highway department.

The general plan is that after projects have been reported to the work committee, the county relief commission, acting for all the political subdivisions in the county, will make application for funds from the state relief commission. In so far as possible local authorities will provide funds for the purchase of material so that the relief funds can be used for labor.

Extensive projects such as flood relief work which are of a national character will be referred to the federal government for consideration.

Federal Control Over Water Power Widely Extended

FEDERAL jurisdiction over water power development has been widely extended as a result of a decision rendered by Judge Luther B. Way in the U. S. district court in Virginia in a suit brought by the Appalachian Electric Power Co. to determine the Federal Power Commission's right to exercise control over its power development in the New River in Virginia, a stream that is not navigable. The court held that under the provisions of the federal Water Power Act the company must obtain a license from the power commission before it can undertake construction of its power plant and must submit to the power commission's regulations as to costs, security issues and rates, including recapture by the government at the end of the 50-year license period.

Special interest centers in the suit as a test case to determine the power commission's right to exercise full control over power plants built on rivers not actually used by commercial navigation. Such rivers are covered by a clause in the Water Power Act authorizing the commission to require a license for power developments on streams where changes in the flow might affect the navigability of channels into which they discharge. Broadly interpreted, that provision would greatly extend the jurisdiction of the federal government over water-power development. As the New River is a major tributary of the Kanawha, a navigable river, the commission, under this provision of the act, required the Appalachian Electric Power Co. to apply for a license.

The state of Virginia, which had authorized the company to build its New River plant, supported the Appalachian Electric Power Co. in its claim that the power project was beyond the jurisdiction of the power commission. Because of the need for an early determination of the question at issue the case is expected to be carried to the U. S. Supreme Court.

◆

Collusion Reported in Bids for Cement for Iowa Roads

There is abundant evidence to establish collusion and conspiracy on the part of cement companies who have supplied cement for road work in Iowa, according to the report of a special investigating committee appointed by the Iowa House of Representatives. The report also criticizes Fred R. White, chief engineer of the State Highway Commission, for alleged neglect in accepting the cement bids and not notifying the governor and the attorney-general of facts and circumstances surrounding the bidding. In commenting on the report Mr. White called attention to the fact that the practice of cement companies to submit identical bids is not peculiar to Iowa.

South Carolina Authorizes Loans From R.F.C. for Waterworks

A bill authorizing municipalities to borrow money from the Reconstruction Finance Corporation for the construction of waterworks, the loan to be repaid out of earnings of the waterworks, has been passed by the legislature of South Carolina and approved by the governor.

◆

Denver to Spend $1,080,000 on Moffat Tunnel Supply Line

An expenditure of $1,080,000 upon the work of bringing water from the west slope of the mountains through the pioneer bore of the Moffat tunnel was approved by the Board of Water Commissioners of Denver on March 28. Recently the commissioners awarded a contract for the pipe line to bring water from the Fraser River and Jim Creek to the shaft at the west portal of the pioneer tunnel. The commissioners already have spent about $910,000 on the work, which includes putting a permanent lining in the tunnel.

◆

Studies Begun for Canal Routes for Ship Canal on Pacific Coast

Organization of the Puget Sound-Grays Harbor-Columbia River Canal Commission, authorized by act of the 1933 session of the legislature of the state of Washington, is being pushed to completion and surveys for the location of the canal and estimates of its cost are to be undertaken immediately. Thomas G. McCrory has been appointed office engineer of the commission. The commission will make its main office at Olympia, Wash., and will establish field survey headquarters at Aberdeen. Possible routes will be located first by means of an aerial survey.

The commission is required to report to the governor by June 8, 1933 as to the route of the proposed canal, its cost and feasibility.

◆

Court Finds Bribe Passed in Los Angeles Dam Work

Sidney T. Graves, former chairman of the Los Angeles, Calif., county board of supervisors, on Mar. 30 was found guilty by a superior court jury of a charge of having accepted an $80,000 bribe during his term of office. Decision of the jury was announced after 29 hours of deliberation. The charge upon which Mr. Graves was tried was made by the county grand jury following an investigation involving the payment of $830,000 by the county to the contracting firm of Fisher, Ross, MacDonald & Kahn in settlement for their loss of the contract to build the $25,000,000 San Gabriel Canyon high dam, which had to be abandoned as an unsafe project. The indictment upon which Mr. Graves was convicted charged that he received an $80,000 bribe from Alan MacDonald, Felix Kahn and Charles D. Ross. Counsel for Mr. Graves announced that a motion for a new trial would be presented when Mr. Graves appeared before the court for sentence. If a new trial is denied, he faces the possibility of a prison term of one to fourteen years.

Chicago Sanitary District Asks Bond Issue Without Referendum

In view of the recommendation in master's report to the U. S. Supreme Court in the application of the Lake States for summary action to compel the Sanitary District of Chicago to complete the sewage treatment program by Dec. 31, 1938, the district has had a bill introduced in the Illinois legislature which would permit issuance of $139,000,000 of bonds by the district without a referendum vote. This amount will complete the scheduled work. While favorable action will not be of immediate benefit or make the district's bonds any more saleable, except for the advantage of a 6 per cent coupon instead of the usual 4½ per cent rate, this action has been taken because the legislature will not meet again for two years. There are already on the shelves of the district $43,000,000 worth of bonds, unsold because of defaults on existing obligations. The defaults are due to the Cook County tax muddle which has held up collections for nearly two years.

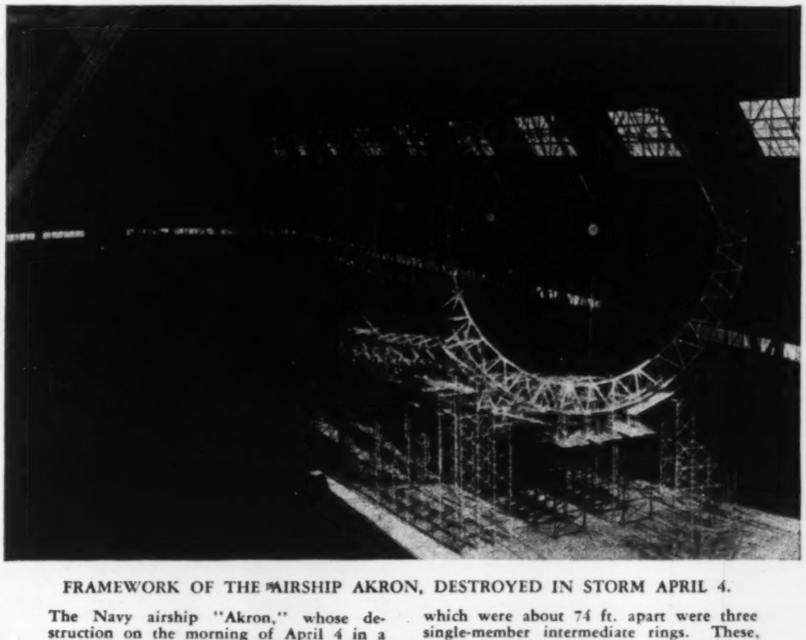
If the district were in funds it could resume work immediately on $8,800,000 worth of unfinished contracts. Plans and specifications are available or will be so that additional contracts totaling approximately $20,000,000 can be let within the next twelve months. Application for a loan of $36,300,000 is on file with the R.F.C. but held up pending liberalization of the Relief Act, since revenue of the district depends largely on the tax levies and is only partly "self-liquidating." When taxes are collected normally by Cook County, the district will be able to continue its schedule laid down by the Supreme Court.

Many of the engineers of the district on furlough due to the lack of funds to pay them have been recalled and design work has been resumed.

◆

Large Union Station Proposed for Railways of Mexico City

Plans for a union railroad station to serve Mexico City are to be laid before the directors of the National Railways of Mexico on April 6. They call for the construction of a depot on the land now occupied by the Colonia station, the railway company's principal station in Mexico City, and for the use of the sation by the company and by the Mexican Railway, a British-owned line to Vera Cruz. The proposed station would cost $650,000.



FRAMEWORK OF THE AIRSHIP AKRON, DESTROYED IN STORM APRIL 4.

The Navy airship "Akron," whose destruction on the morning of April 4 in a storm off the New Jersey Coast resulted in the death of 73 of its total personnel of 76, incorporated in its duralumin framework the most modern principles of airship construction. Its sister ship, the "Macon," just completed, is of identical design. As compared with the "Shenandoah," which broke in two in a wind storm several years ago, the "Akron" had unusual longitudinal rigidity by virtue of three keels or stiffening girders instead of one as in previous ships; one of these keels was at the top, the other two in the lower half at 45 deg. to the vertical center line; in makeup they were three-chord trusses or triangular frames. The main rings (actually 36 and 24-sided polygons) were of similar triangular construction and thus self-supporting as compared with the early single-member rings which relied for stiffness largely on the tension in the bulkhead wire network used to separate the individual gas cells in the hull. Between each two main rings which were about 74 ft. apart were three single-member intermediate rings. These, together with the light cross-wiring of the bulkheads and the diagonal wiring in the outside panels between the ring girders, completed the structural framework of the "Akron," although the fabric covering was also designed to assist in transmitting shear stresses. The "Akron" had a gas capacity of 6,500,000 cu.ft. as compared to 3,700,000 cu.ft. in the "Graf Zeppelin." It was 785 ft. long and 132.9 ft. in maximum diameter.

Apparently neither structural deficiencies nor failures contributed to the disaster. Lieutenant Commander Herbert V. Wiley, executive officer of the ship and one of the survivors, stated that the "Akron" became entirely surrounded by lightning, that it began to descend rapidly from an altitude of 1,600 ft., at the same time shifting violently. During this buffeting the rudder was carried away and the ship was out of control. He stated that the ship was demolished by the impact as it struck the water.

Water Project at Dearborn Abandoned for the Present

The proposed water works system for the City of Dearborn, Mich., has been abandoned or postponed for at least three years and the question of a $2,093,000 bond issue was removed from the April 3 ballot following the consummation of a new agreement with the Detroit Department of Water Supply to supply Dearborn with water at a lower rater than applied in the past. Based upon the amount of water supplied to the Dearborn distribution system last year, the new rate will be 45 cents per thousand cubic feet of water as compared with the rate of 62 cents under the old agreement. The new agreement can be terminated by the suburban city at the end of three years' notice.

◆

Committee Named by R.F.C. to Aid in Earthquake Work

Acting under the joint resolution of Congress approved on March 23, the Reconstruction Finance Corporation has named a special advisory committee to aid in the prompt financing of repair or reconstruction work in the territory damaged in the Long Beach earthquake of March 10. Congress has authorized the R.F.C. to loan up to $5,000,000 for this work. The committee named by the corporation is as follows: H. S. McKay, chairman; Zach J. Farmer, Arthur S. Bent, H. T. Cory, and A. R. LeRoy, manager of the Los Angeles Loan Agency of the corporation, all of Los Angeles; J. F. Burke, Santa Ana; George H. Coffin, Hollywood; George M. Spicer, Long Beach.

◆

Chicago Makes Start On New Pumping Station

Final authorization was given March 31 by the Chicago city council to proceed with the new 300-m.g.d. Harrison St. pumping station project for which the R.F.C. furnished $2,327,000 last year. Contracts for cast-iron pipe were awarded on that date to James B. Clow & Co. for 2,450 tons of 30- and 36-in., Class B, cast-iron pipe at $33.96, total $80,752, and to United States Pipe & Foundry Co. for 6,300 tons, 48-in., class B, cast-iron pipe at $32.754 and 1,160 tons 48-in., Class C, cast-iron pipe at $32.754, total $244,344; also for 350 tons of special castings at $71.585, total $25,054. All figures include the new state tax of 3 per cent, effective April 1, which may or may not be imposed on the city.

Bids are called for April 15 for wrecking the old Harrison St. station, also for providing six Venturi meters. On April 20 bids will be received for six 50-m.g.d. motor-driven centrifugal pumps operating at 514 r.p.m. under 136 ft. head and to be equipped with 1,500-hp. synchronous motors.

Cash has been advanced and the money is on deposit in Chicago for this work. In 1929 the city was authorized by the state legislature to issue $3,000,000 water works improvement bonds annually without referendum. The issuance privilege is not cumulative; in consequence the 1932 quota had to be sold in 1932.

Washington Notes

By Paul Wooton

Washington Correspondent

Plans for the development of Muscle Shoals and the Tennessee basin will be presented to Congress within a week, following final conferences between President Roosevelt, Senator Norris and other congressional advocates. A general public works program will not be ready for some time but will be submitted to Congress before the close of the special session. Only such public works as will employ the largest percentage of direct labor will be considered. Adoption of this guiding principle by the President indicates that an indefinite number of projects, the appropriations for which have been diverted to the forestation program, will be abandoned.

President Roosevelt has been studying all legislation, past and present, that has been proposed with reference to Muscle Shoals and his message to Congress will be accompanied by a legislative draft, as has been his custom on other matters. In formulating his plans the President has conferred individually with Senators Norris, of Nebraska, McKellar and Backman, of Tennessee, Black and Bankhead, of Alabama, and Reps. Hill and Stegall, of Alabama.

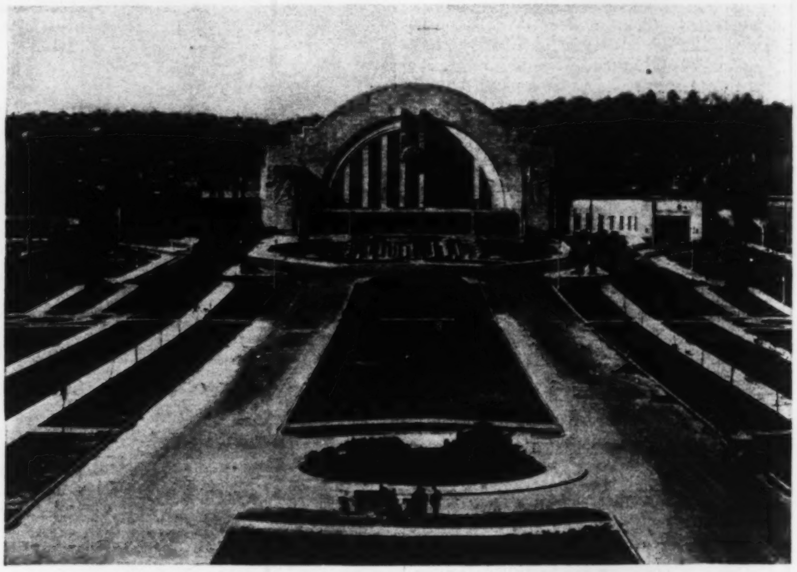
The emphasis that has been placed by President Roosevelt on the principle that employment is the primary factor to be considered in a public works program is exemplified by his views on the construction of *new* waterways. The projects chosen will be those on which the greatest amount of human labor can be employed.

A delegation of the National Rivers and Harbors Congress also has learned that President Roosevelt expects vessels and barge lines—in short everything that floats—to pay the expense of maintaining *existing* channels and aids to navigation. The President is considering a proposal to assess a small tonnage tax producing sufficient revenues to meet annual expenditures. He has been much impressed by the fact that in other countries such expense is borne by the users of the service.

◆

Water Level Ordered Reduced in the Mulholland Reservoir

Mulholland reservoir in Hollywood, Calif., the safety of which has been the subject of considerable debate between Hollywood residents and the Los Angeles City Council in recent years, will be drained to one-fourth of its capacity by order of the Los Angeles Board of Water and Power Commissioners. Storage of water behind the dam will be limited to 1,850 acre-ft. Capacity of the reservoir is 7,400 acre-ft. The board also instructed its chief engineer to prepare plans and specifications for building a fill below the dam. If built, this fill will reach to the crest of the dam, and will be terraced and landscaped. Decision to reduce the water level was issued despite reports of a geologist that the dam, its foundation and abutments had been examined since the Southern California earthquake of Mar. 10 and found unimpaired.



NEW RAILWAY TERMINAL OPENED AT CINCINNATI.

The new union railway station in Cincinnati, built at a cost of $41,000,000, was opened officially on March 31. Unofficial opening took place some days before the formal ceremony because high water in the Ohio River had made operation of the old union station difficult.

The new station is planned to accommodate 17,000 passengers per day and to permit a combined in and out movement of 260 trains each 24 hours. Activities heretofore carried on in the old Central Union station, the Cincinnati, Hamilton and Dayton station, the Court Street and Fourth Street stations and the Pennsylvania station, are combined in the new station. A description of the terminal and details of some of the structures have been published in Engineering News-Record, Feb. 26, 1931, p. 348 and June 9, 1932, p. 817.

The new terminal was begun in August, 1929. It has been built by the Cincinnati Union Terminals Co. with Henry M. Waite as chief engineer. In addition to the cost of the new terminal facilities the seven railroads served will spend $80,000,000 in yard and track changes necessitated by the new layout.

Bids Opened for Tunnels of Colorado River Aqueduct

Bids on the construction of the Bernasconi and Valverde tunnels of the Colorado River aqueduct were opened by the Metropolitan Water District of Southern California on April 3. The tunnels are 1.1 and 7.2 miles long respectively, and bids were called on driving them to full 15 ft. 3 in. diameter and to 11 ft. 9 in. diameter.

Low bids were as follows on the two proposals: Bernasconi tunnel; Hamilton & Gleason Co., Denver, $412,055 and $354,097; east portion of Valverde tunnel, Dravo Contracting Co., Pittsburgh, $1,584,614 and $1,369,974; west portion, Valverde tunnel, Dravo Contracting Co., $1,701,989 and $1,491,206. The Dravo firm also bid $3,136,603 for the entire Valverde tunnel.

A low bid of $24,217 for laying the 60-mile water supply line for the east end of the aqueduct was submitted by the Lang Transportation Co. of Los Angeles, and for the reservoirs of the line Chalmers & Winters of Los Angeles bid $10,264.

◆

Survey Completed for First Dam of Rio Grande Control Project

Surveys for the first of a series of dams in the Rio Grande valley proposed by the International Boundary Commission have been completed, according to W. E. Anderson, engineer of the Commission. The dam when built will be located 16 miles above Roma, Texas. Surveys for a second dam to be located 50 miles above Laredo have been started.

The dam above Roma will provide a minimum head of 36 ft. for the development of power and the installation of a hydroelectric plant is included in the planning for the project.

Recently representatives of the Mexican and American governments signed a convention providing for rectification of the river channel from El Paso, Texas, to the Box Canyon below Fort Quitman, Texas, a distance of 155 miles. (*ENR*, Feb. 16, 1933, p. 226.)

◆

Many Projects Put Forward for Public Construction Program

As a result of indications from Washington that the Administration expects to support a large program of public construction, numerous projects are being put forward for consideration by the Administration. Included therein is the long-discussed ship canal across the Florida peninsula near the Georgia line to save about 800 miles in the round trip between Atlantic and Gulf ports, reclamation and afforestation of the Congaree-Wateree-Santee river basins, and numerous flood control projects in the Ohio valley. Since the recent high water in the Ohio River interest has been revived in the proposal of the Pittsburgh Flood Commission for the construction of 17 storage reservoirs on the head waters of the Monongahela and Allegheny rivers. Senator Robert J. Bulkley also proposes the construction of flood retaining reservoirs on the Scioto, the Hocking and the Muskingum rivers similar to those built in the Miami valley.

In California, efforts are being made to have the state's $160,000,000 water conservation project considered.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, June 27-30.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, June 26-30.

AMERICAN WATER WORKS ASSOCIATION, annual meeting, Chicago, June 12-16.

AMERICAN WELDING SOCIETY, annual meeting, New York, N. Y., April 27-28.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 25-30.

ILLINOIS SECTION, American Water Works Association, will hold its annual convention at Rockford, Ill., April 19-20.

MID-SOUTH SECTION. American Society of Civil Engineers, has set the date of May 5-6 for its annual meeting to be held in Vicksburg, Miss.

FLORIDA SECTION, American Water Works Association, will hold its short course in water treatment at the University of Florida, Gainesville, April 10-12.

A JOINT MEETING of the Nova Scotia, New Brunswick and Prince Edward Island branches of the Engineering Institute of Canada, of local provincial engineering organizations and of college technical societies is to be held at White Point Beach, Nova Scotia, July 27-28.

PENNSYLVANIA CONSTRUCTION COUNCIL, at its recent annual meeting elected the following officers: President, Henry H. Wilson, of Winston Bros. Co. and H. H. Wilson, Harrisburg; vice-presidents, Ray V. Warren, Pittsburgh; George C. Britton, Portland Cement Assn., Philadelphia; M. L. Jacobs, Bethlehem Mines Corp., Bethlehem; Wm. F. McCrady, McCrady-Rodgers Co., Pittsburgh; F. Herbert Snow, consulting engineer, Harrisburg.

◆

Brief News

A Proposal to Abolish the Board of Water Commissioners of Denver, Colo., and to authorize the mayor to appoint a manager for the water system is to be put to vote in Denver on May 15.

Construction of Two Dams at Springfield, Ill., has been begun by the Carson Co. of Chicago. The dams, costing half a million dollars, are part of a $2,500,000 lake project. They are to be completed by Dec. 15.

Plans for New Buildings for the Dillard University project at New Orleans have been approved by the trustees of the institution and it is expected that bids will be called at an early date. The entire project involves $1,500,000 of new construction.

Three Engineers are members of the committee appointed by the mayor of New York to study the city's immediate need for water, announced in our issue last week, instead of two as stated in that announcement. The third engineer is Edward De V. Tompkins.

Construction of a New Power House for the Baltimore City Hospital at an estimated cost of $270,000 has been approved by the Public Improvement Commission of Baltimore and Bernard L. Crozier, chief engineer, has been authorized to proceed with the preparation of plans.

Extensive Planting of Roadside Trees throughout the state of Illinois is to be undertaken as part of the state's program for providing work for the unemployed. Trees are to be supplied from the nurseries owned and operated by the state and labor will be provided by the county chairmen of the emergency relief committees.

Incorporation of the Sarnia-Port Huron Vehicular Tunnel Co. as provided in a bill before the Canadian Parliament was strongly opposed at a hearing held in Ottawa recently. The bill would authorize the company to construct a tunnel from Sarnia, Ont. to Port Huron, Mich.

Construction of a $175,000 Pier by the Port Commission of Seattle, Wash., has been halted by a temporary restraining order issued in the superior court at the request of the voters of the city. The port commission initially called for bids to be opened on April 4. The structure was to be of wood, 450 ft. long and 150 ft. wide.

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Personal Notes

George Burnet, civil engineer, has been elected mayor of Fort Dodge, Iowa.

Major Douglas H. Gillette, who has been engineer for the Arlington Memorial Bridge Commission since 1930, has been appointed assistant to the director of public buildings and public parks of the national capital.

T. W. Osgood, former assistant superintendent of safety of the California Industrial Accident Commission, has been appointed safety engineer on the Colorado River aqueduct project of the Metropolitan Water District of Southern California.

Edward Grimstead, Constantia, N. Y., has been appointed engineer in charge of highway work in Oswego County to succeed Irving H. Smallwood of Baldwinsville, who has been placed in charge of work for the state in Onondaga County and part of Cayuga County.

W. D. M. Allan, manager, cement products bureau, Portland Cement Association, has been appointed director of promotion of the association including the advertising and publication department, cement products, highway, municipal, railway and structural bureaus. W. G. Kaiser, assistant manager of the cement products bureau, has been appointed manager to succeed Mr. Allan.

Z. E. Sevison, for the past sixteen years state highway engineer in Wyoming, is to be retired by the new highway commission when his term expires in June. Mr. Sevison has been executive head of the highway department since its organization in 1917. He is president of the Western Association of State Highway Officials and for many years was a member of the executive committee of the American Association of State Highway Officials. In point of service he is the oldest highway executive in the country.

C. P. Fortney, chairman and chief engineer of the State Roads Commission of West Virginia, resigned from the commission on March 31 after 14 years of service in the highway department of the state. Mr. Fortney was appointed a member of the State Roads Bureau in 1919 and in 1921 upon the formation of the present commission, he was appointed its first chairman. Mr. Fortney began engineering work as a chainman and rodman on railway construction in 1901 and after graduation from West Virginia University in civil engineering in 1907 he went to the Panama Canal where he became superintendent of masonry construction at Gatun. Subsequent to the completion of the canal work, he was on river and harbor work and during the world war served on the staff of the Chief of Engineers in Washington.

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Obituary

Frederick W. Parsons, vice president, Ingersoll-Rand Co., died at his home in Corning, N. Y., on April 1, age 67 years. Mr. Parsons had specialized in the development of compressed air equipment. He was manager of the Painted Post, N. Y. and the Athens, Pa., plants of the company.

Henry C. Breidert, chief contracting engineer, Fort Pitt Bridge Works, Pittsburgh, Pa., died March 14. He was born in Pekin, Ill., in 1875 and graduated from the University of Illinois as a civil engineer. He was city engineer of Havana, Ill. and then assistant engineer with the consulting firm of Alvord & Shields, Chicago, each for a year. Thereafter his employment was entirely with the Fort Pitt Bridge Works, starting as draftsman. In 1909 he was western contract manager in Chicago, returning to Pittsburgh in 1924. He was a member of the American Society of Civil Engineers, Western Society of Engineers and Chicago Engineers Club.

William O. Gloster, associate engineer, Huntington District, U. S. Engineer Dept. died at Marietta, Ohio on March 24. Mr. Gloster was a graduate of the University of Tennessee and had been in the civilian engineer corps of the army for many years.

J. W. Walker, chairman of the Board of the Pittsburgh Construction Co., died at his home in Valley Forge on April 1, age 90 years. Mr. Walker was a graduate of the Polytechnic College at Philadelphia in the class of '63 and began work with the engineering department of the Pennsylvania Railroad.

William J. Martz, retired engineer of Seattle, Wash. died there recently. For 27 years before his retirement Mr. Martz was in the city engineering department.

◆

Engineering Contracts and Capital

While federal and municipal contract awards followed the low trend of the past four weeks, one large private contract raised the week's total of heavy engineering construction awards to $17,256,000, a gain of more than 5 millions over the previous week's total. The large contract was that for an $8,000,000 slum clearance project in New York City, which entered the contract stage with the approval of a loan by the Reconstruction Finance Corp. Federal contracts amounted to only $2,009,000, and are expected to continue low because of the government's policy of holding up new work pending a definite public works program. State and municipal awards were also low, amounting to $4,889,000, about the same as for the past four weeks. Numerous large projects scheduled for award later in the month, some postponed from early March, will help this class of construction, though highway work is being curtailed until a definite federal aid schedule is announced. Highway lettings for the past week aggregated $2,540,000, of which nearly $800,000 was for cement requirements of the Indiana highway department.

New productive capital issues sold last week amounted to only $480,000, all public issues. The R.F.C. announced approval of four new self-liquidating loans totaling $10,880,500. The total of approved loans of this character to date is $202,131,399. Actual advances on approved loans total $14,682,000 to date.

Review of first quarter

In cumulative totals of contracts awarded during the first quarter of 1933 compared with the similar period in 1932, several classes of construction show surprising gains over the previous year, although the total of all contracts to date this year is $213,839,000 as compared with $269,511,000 in 1932. Public works awards during the first three months of this year are almost exactly the same as last year, totalling $150,784,000 as compared with $150,787,000 last year. Private construction this year, however, is only about half of what it was during the first quarter of last year, amounting to $63,075,000 as compared with $118,724,000 for 1932. In the public works field, contracts awarded during the first quarter of 1933 showed gains over those of 1932 in the waterworks, sewer, earthwork and waterways, streets and roads, and federal classifications. Losses were registered in the public bridges and public building classifications. In the private field, industrial buildings for the first quarter of 1933 amounted to $26,376,000, a gain of almost two million over the same period of last year. All other private classifications showed losses.

Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average		Week
	Apr., 1932	Four Weeks	Apr. 6, 1933
Federal government	$2,912	$2,294	$2,009
State and municipal	14,799	4,555	4,889
Total public	$17,686	$6,849	$6,898
Total private	7,882	4,874	10,358
Week's total	$25,586	$11,743	$17,256

Cumulative to date	
1932	$295,097
1933	231,095

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average		Week,
	Apr., 1932	Four Weeks	Apr. 1, 1933
New capital issues	$11,500	$1,698	$480

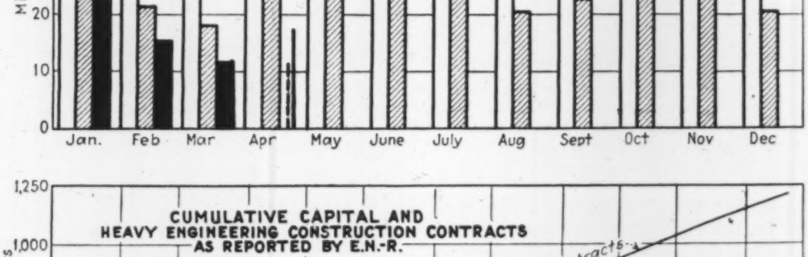
Cumulative to date:	
1932	$249,000
1933	68,886

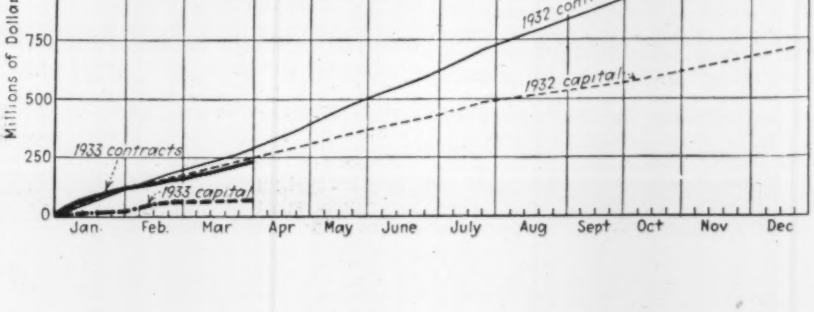
R.F.C., self-liquidating loans:	
Approved current week	$10,931
Approved to date (including 1932)	202,131
Actual loans made (including 1932)	19,682

◆

ENR Cost and Volume Index

E.N.-R. Cost		E.N.-R. Volume	
April, 1933	**160.16**	**March, 1933**	**62**
March, 1933	158.44	February, 1933	82
April, 1932	153.12	March, 1932	97
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100		





Construction Equipment and Materials

Blower for Manhole Ventilation

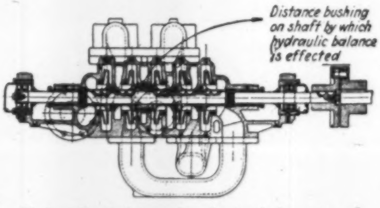
For ventilating and driving off gases from manholes, tunnels and other enclosed places where electric power is not available, a gasoline engine driven blower has recently been placed on the market by the Coppus Engineering Corp., Worcester, Mass. Power is provided by a ¾ hp. air-cooled gasoline engine, operating at 1,800 r.p.m. The device is mounted on heavy coil springs to cushion the vibration. It is capable of delivering 1,550 cu.ft. of air per minute. By means of an 8 in. flexible tubing, the air flow can be directed to any desired point. The unit weighs 105 lb. and it is said that it can be set up in a space 2 ft. square.

Engine-driven blower for ventilating manholes.

◆

Bushing Gives Hydraulic Balance In New Centrifugal Pump

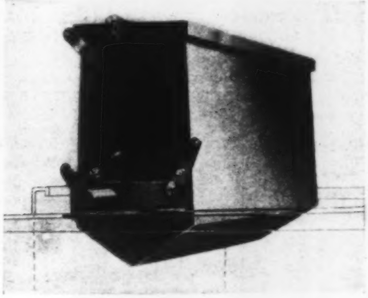
The Pennsylvania Pump & Compressor Co., Easton, Pa., has developed a new method of maintaining hydraulic balance in its multi-stage centrifugal pumps. The impellers of these pumps are arranged so that the suction inlets are opposed to each other, with two directly opposed impellers located at about the center line of the pump. The hydraulic balance is accomplished by placing a properly proportioned distance bushing between the two directly opposed impellers, the diameter of this bushing being of such value as to put the rotating element in complete hydraulic balance. The manufacturer states that in this manner positive hydraulic balance is effected over practically the entire range of the capacity head regardless of the number of stages or whether the stages employ an even or odd number of impellers. A ball thrust bearing is incorporated in the outboard bearing to take care of unusual conditions and to insure the proper alignment of rotating parts.


Distance bushing on shaft by which hydraulic balance is effected
Hydraulic balance is obtained by use of properly proportioned distance bushing.

◆

Tank for Hauling Bulk Cement

Blaw-Knox Co., Pittsburgh, Pa., has developed a new type of tip-over tank for hauling bulk cement in compartment trucks on road construction, which it is calling the Cementank. The tank is a steel container with hinged steel cover and is supported on the sides of the truck. It is filled with cement at the proportioning plant and then dumped into the skip of the paving mixer at the same time that the load of aggregate is released.


Blaw-Knox Co.'s "Cementank"

The Cementank is oversize in capacity to take care of bulking of cement, which usually swells the volume considerably. The manufacturer states that the tank cannot leak and is weatherproof at all times. It is held upright by means of a latch to prevent accidental dumping. When the latch is released and the truck body is elevated the tank turns over automatically and discharges its batch of cement.

◆

New Road Maintenance Machine

The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., announces the new A-C "Speed Patrol" for road maintenance. Its outstanding features include ball and socket wear take-up joints on the moldboard assembly, a 95-in. blade base, full power control, a 42 hp. engine, four speeds forward, a normal maintenance speed of 5 miles per hour, bolted construction throughout with fine threads and high nuts, 64 in. full circle, blade pressure of 7,240 lb. without scarifier, and dual brakes.

New A-C Speed Patrol

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New Equipment in Brief

Compressors. Davey Compressor Co., Inc., Kent, Ohio, has introduced a low-weight compressor which can be mounted on a long-wheelbase motor truck and which takes its power from the truck motor. The compressor has sufficient capacity to operate two pavement breakers or one jackhammer. The compressor assembly has a weight of 965 lb.

Paving Block. A new composite paving block has been announced by the Ultimite Block Co. of America, 40 Wall St., New York, comprising fragments of wearing material securely embedded in an appropriate matrix. According to a statement by the company the block presents a durable wearing surface, is uniform in size, can be rolled and is cheap to make.

Paint Pigment. The Eastern Mabelite Corp., 225 Mercer St., New York, N. Y., announces that through the medium of a new grinding process of Mabelite ore, a new pigment has been produced which, when mixed with any normal oil paint vehicle, produces a metal primer that affords protection against atmospheric conditions and mild solutions of acids, alkalies and brines. Mabelite ore contains a conglomerate of ferric oxide, silica and alumina.

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Business Notes

CHAIN BELT CO., Milwaukee, Wis., announces that it has appointed A. S. Kennedy manager of its new branch office in Kansas City. Chain, power transmission equipment, elevators, conveyors, traveling water screens, sanitation equipment and Stearns belt conveyor idlers, manufactured by the Chain Belt Co., which have formerly been marketed in this territory through their St. Louis office, will now be handled through the Kansas City office.

HENRY S. BEAL, general manager, Jones and Lamson Machine Company, machine tool manufacturers, Springfield, Vt., on Feb. 24 was elected president of the Sullivan Machinery Company, Chicago, Ill. Mr. Beal succeeds Arthur E. Blackwood, who becomes chairman of the board of directors. He has been president since the death of Frederick K. Copeland in 1928. Mr. Beal was born in Rockford, Ill., in 1888, was graduated from Dartmouth and also studied at the University of Berlin. For the past three years he has been a director of the National Machine Tool Builders Association and is now its president.

Business Side of Construction

Contracts Affected by Bank Holiday and Uncertainty of Public Works

CONSTRUCTION ACTIVITY in March, as measured by awards of heavy engineering construction contracts, was at a 12-year low ebb due to effects of the bank holiday early in the month and almost complete stoppage of new federal work and road lettings pending determination of a public works program and the status of federal highway aid. The Bureau of Public Roads notified the states of a temporary postponement of new road construction projects involving federal aid, pending completion of President Roosevelt's new building and unemployment relief program. The order does not affect federal aid projects already under contract. Until the administration program is arranged the Bureau will not concur in the awarding of new contracts. As a result, many states will postpone new contract awards until the status of the federal aid allotment is definitely known. All construction of federal buildings yet to be contracted for are being held up by the Treasury Department until the new building program has been worked out. All buildings already under contract will proceed, but many bids received for new federal construction or for sites to erect them on will not be acted upon for the time being. State and municipal construction was severely pressed by the bank holiday. Most contracts scheduled for award during the holiday and all bids called for during the same period were postponed.

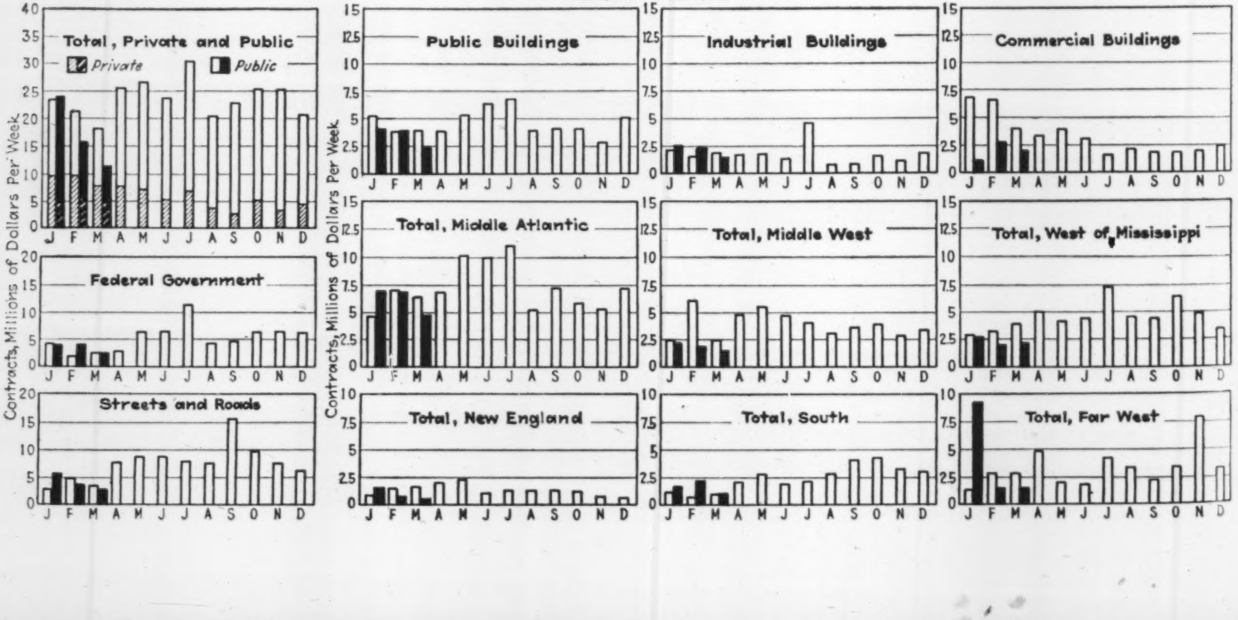
In the face of these conditions it is no wonder that the total engineering construction contracts reported for the month of March (five weeks) reached the low total of $57,934,000, or an average of 11.6 millions per week, the lowest weekly average since February, 1921. The weekly average of contracts awarded in February was 15.1 millions, in January 23.8 millions and for the year 1932, 23.5 millions. March average awards were 4.7 millions for private work and 6.9 millions for public works. Private construction, while remaining low in comparison with years prior to 1932, is holding up well under the circumstances, the March average, while slightly under February, is well above the average of the last half of 1932. Public works awards had dropped from a weekly average of 19.4 millions in January and 9.6 millions in February.

In the geographical distribution of contracts for the month of March, all four districts east of the Mississippi River registered a decline from February and January figures, while the Far West remained the same as February. The only district showing a gain for March was the area west of the Mississippi, which gained an average of $200,000 per week over February.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN MARCH 1933
Five Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States March, 1933	United States Three Months 1933	United States Three Months 1932	Canada March 1933
Public Works										
Waterworks	128	440	130	527	861	1,036	3,122	24,829	6,489	15
Sewers	184	141	115	336	341	82	1,199	4,084	393	
Bridges, public	1	1,120	384	88	801	285	2,679	9,684	10,307	
Earthwork and waterways	286	671	502	268	281	489	2,497	18,879	10,844	
Streets and roads	440	1,460	1,603	2,311	4,359	3,284	13,457	49,279	48,468	984
Buildings, public	316	6,958	1,044	1,558	345	737	10,958	42,124	54,991	....
Unclassified, public	68	103	55	30	10	379	645	1,905	12,550	75
Total public	1,423	10,893	3,833	5,118	6,998	6,292	34,557	150,784	150,787	1,074
Federal gov't. (included in above classifications)	566	5,889	1,662	1,700	499	2,374	12,690	42,185	36,533	....
Private										
Bridges, private	.....	286	.....	62	.....	.....	348	1,790	890	....
Buildings, industrail	618	3,271	576	1,768	532	772	7,537	26,376	24,502	153
Buildings, commercial	573	8,119	150	880	138	105	9,965	24,833	73,396	188
Unclassified, private	20	455	1,270	35	3,597	150	5,527	10,056	19,936	....
Total private	1,211	12,131	1,996	2,745	4,267	1,027	23,377	63,055	118,724	341
March, 1933 (5 weeks)	**2,634**	**23,024**	**5,829**	**7,863**	**11,265**	**7,319**	**57,934**	......	......	**1,415**
February, 1933 (4 weeks)	2,437	26,824	9,526	7,780	7,937	6,009	60,513	......	......	412
March, 1932 (5 weeks)	7,816	31,823	4,554	12,377	19,422	14,124	90,116	......	......	..630
Three months, 1933	11,177	77,201	21,698	24,283	29,655	49,825	.....	213,839	......	2,629
Three months, 1932	20,209	104,113	13,018	49,904	45,914	36,353	.....	......	269,511	1,353

CONTRACTS REPORTED - WEEKLY AVERAGES - 1932-1933



Materials notes

Cement—The Portland cement industry in February, 1933, produced 2,772,000 barrels of cement shipped 2,275,000 barrels from the mills and had in stock at the end of the month 21,121,000 barrels. Production in February showed a decrease of 30.2 per cent and shipments a decrease of 27 per cent, as compared with February, 1932. Stocks at the mills were 20.8 per cent lower than a year ago. Production in February was rated at 13.4 per cent of capacity, as compared with 18.7 per cent capacity production in February, 1932. Production in February increased over that of January, which was rated at 12.9 per cent of capacity.

Steel—Compilations by the American Iron & Steel Institute show that for the month of February the total output of steel ingots was 1,065,000 tons, rated at 20.39 per cent of capacity of the industry, as compared with an output of 1,006,000 tons in January, rated at 17.78 per cent of capacity. Preliminary reports from the steel industry indicate that the January and February gains were wiped out during the first two weeks of the month when production dropped to barely 15 per cent of capacity. The rate of production fell to about 13 per cent towards the end of March.

Lumber—The downward trend in the lumber business recorded in February was reversed in the first week of March with consistent gains showing for each week of the month. New business booked at the lumber mills during the week ended March 18 was 31 per cent above the previous high week of 1933, according to reports of the National Lumber Manufacturers Association.

Labor notes

St. Louis—St. Louis Building Trades Council is demanding a continuation of present union wage scales on construction work for one year, and threatens to impose penalties on any union worker accepting wages under the set scale. The Associated Building Interests, an organization of contractors in the city, has refused to accept the union's demand for continuation of present scales and has notified its members that they may employ labor at whatever wages they can get them to work for after April 15, when the present working agreement with the various unions expires.

Cement Industry—The International Cement Corporation has announced that simultaneous with the increase of 10 cents per barrel in the price of cement at several of its mills, wages at these plants have been increased 10 per cent.

Boston—At a meeting held March 13, representatives of 33 trade unions of the Building Trades Council of Boston unanimously reported in favor of a 24-hour week as a temporary measure and a permanent 30-hour week in construction, and reported against proposed wage cuts of 25c. to 45c. per hour. A general strike of 20,000 building trades workers is threatened on May 1 if proposed wage cuts are put into effect on that date. Bricklayers and carpenters, who are not affiliated with the Council, were represented at the meeting and were in accord with the other trade unions. It is expected that a concerted attack on present wages will be made by employers on May 1. Several trades are reported to have already been asked by the employers to take cuts of from 25c. to 45c. per hour.

Cincinnati—All work on the 2½ million dollar post office substation of the new Union Terminal was halted March 29 when approximately 600 union workmen went out on strike. The strike is reported to have been caused by failure of a plumbing contractor to discharge three non-union laborers who had been assisting plumbers.

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Pile Drivers	Structura Iron Workers	Masons' Laborers	Common Laborers
Atlanta.....	$0.75@1.12½	$0.40@.90	$0.60@1.25	....	$0.60@1.25	$0.25	$0.20@.25
Baltimore...	.62½@1.00	.65@.90	1.37½	$0.65	1.00@1.25	.40	.30
Birmingham	.75@.87½	.60	.75	....	.75	.25	.20@.30
Boston.....	.90@1.30	.60@1.17½	.90@1.17½	.70@1.07½	1.00@1.20	.45@.70	.35@.70
Cincinnati..	1.27½	1.02½	1.07½	1.07½	1.20	.70	.40@.45
Chicago....	1.37½	1.31¼	1.31¼	1.31¼	1.35	.88¾	.82½
Cleveland...	.90@1.37½	.75@1.12½	.90@1.12½	1.00	.90@1.06¼	.56¼	.30@.72
Dallas......	.62½	.50	.50	.50	.50	.25	.25@.35
Denver.....	1.00@1.12½	.75@.87½	.75@.87½	....	.75@.87½	.50	.31¼@.50
Detroit.....	.75@1.50	.55@.80	1.25	1.25	1.25	.70	.30@.50
Kansas City	1.30	1.12½	1.12½	1.06	1.12½	.75	.35@.50
Los Angeles.	.62½	.50	.75	.75	.75	.50	.35@.50
Minneapolis	.90@1.00	.75	.75	....	.90	.50	.40@.50
New Orleans	1.00	.75	1.00	.70	1.25	.25@.40	.15@.25
New York..	1.50@1.65	1.25@1.40	1.50@1.65	1.50	1.65	.81¼@1.00	.50@.75
Philadelphia	.75@1.00	.50@.75	.75@1.00	.60@.75	.75@1.00	.20@.35	.15@.25
Pittsburgh..	.60@1.50	.60@1.25	.60@1.37½	1.00@1.18¾	.60@1.37½	.50	.40@.70
St. Louis...	1.50	1.25	1.35@1.47	1.25	1.47	1.00	.30@.78¾
San Francisco	1.12½	.90	1.00	1.00	1.20	.75	.65
Seattle.....	.75@1.20	.50@.90	1.00	.90	1.10	.66	.40@.50
Montreal...	.75	.60	.55	....	.70	.45	.25@.30

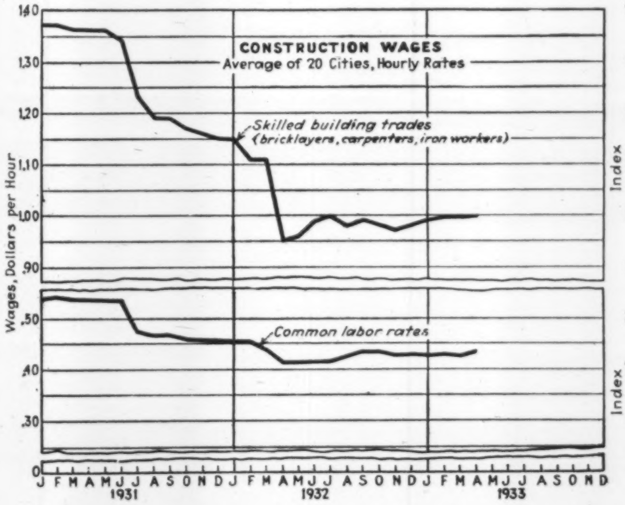
Skilled Average (3 trades) $0.997. Common Average, $0.434

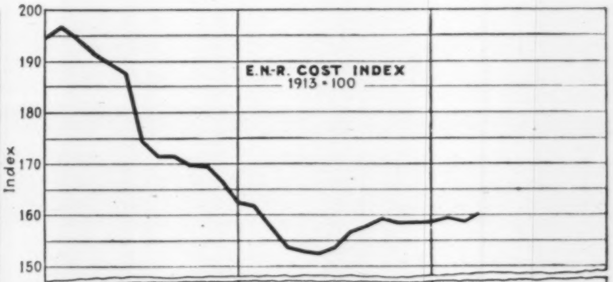
ENR Cost and Volume Index

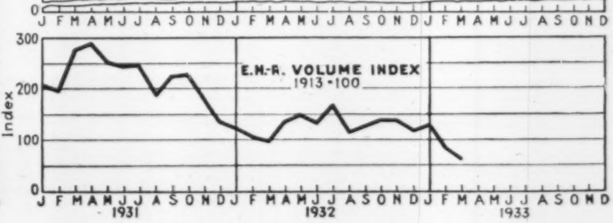
The Engineering News-Record cost index for April is 160.16, the highest since February, 1932. The current gain over the previous month is due to an increase in lumber prices and a slight increase in the average of common labor rates. Cement and steel components of the cost index remain stationary. The Engineering News-Record volume index for March is 62 as compared with 82 for February. The March figure marks the 12-year low record for the index.

E.N.-R. Cost		E.N.-R. Volume	
April, 1933	**160.16**	**March, 1933**	62
March, 1933.....	158.44	February, 1933	82
April, 1932......	153.12	March, 1932.......	97
1932 (Average) ...	156.97	1932 (Average).....	127
1931 (Average) ...	181.35	1931 (Average).....	220
1930 (Average) ...	202.35	1930 (Average).....	260

1913 Average......... 100







Current Prices of Construction Materials

Building Materials

PORTLAND CEMENT — Prices are for carload lots. For cement in returnable cloth bags add 40c. per bbl.; in non-returnable paper bags add 15c. per bbl., to following net prices:

	F.o.b.	Delivered		F.o.b.	Delivered
Atlanta	$2.35	$2.85	Kansas City	$1.70	$1.80
Baltimore	....	2.03	Los Angeles	2.10	2.10
Birmingham	2.02	2.12	Minneapolis	2.20	2.35
Boston	1.92	2.12	Montreal	1.70	....
Chicago	1.60	1.95	New Orleans	1.90	2.10
Cincinnati	2.31	2.46	New York	1.88	2.20
Cleveland	1.77	2.00	Philadelphia	1.94	2.04
Dallas	2.30	2.45	Pittsburgh	1.87	1.97
Denver	....	3.20	St. Louis	1.74	2.15
Detroit	....	2.00	San Francisco	2.05	....
			Seattle	2.55	2.70

Current mill-prices per barrel to dealers, for carloads of 132 barrels or over, without including charge for four bags, f.o.b. Bag charges same as in preceding table:

Alpena, Mich	$1.40	Mason City, Ia	$1.45
Buffington, Ind	1.35	Norfolk, Va	1.61
Dallas, Tex. (Inc. 5c. tax)	1.80	Northampton, Pa	1.40
Hannibal, Mo	1.35	North Birmingham, Ala	1.60
Hudson, N. Y	1.50	Richard City, Tenn	1.70
Independence, Kan	1.45	Saginaw, Mich	1.35
Ironton, Ohio	1.35	Steelton, Minn	1.55
Iola, Kan	1.45	Universal, Pa	1.40
La Salle, Ill	1.35	Waco, Tex	1.75
Limedale, Ind	1.45	Wyandotte, Mich	1.30

SAND AND GRAVEL — Per ton, carload lots, gravel, size ¾-in.:

	Gravel		Sand	
	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$1.95	$2.75	$1.50	$2.50
Baltimore	....	2.55	....	2.08
Birmingham, per cu.yd	....	3.00	....	2.40
Boston	1.40	1.65	.90	1.15
Chicago, per cu.yd	....	2.25	....	2.25
Cincinnati	1.20	1.65	.95	1.40
Cleveland	....	2.00	1.40	2.00
Dallas, per cu.yd	1.40	2.40	1.65	2.40
Denver, per cu.yd	1.75	1.85	1.15	1.20
Detroit	.50	1.45	.72	1.50
Kansas City (at plant)	.65	....	.50	....
Los Angeles	1.35	1.45	.85	1.00
Minneapolis	....	1.60	....	.65
New Orleans	1.40	2.40*	1.20	2.00*
New York, per cu.yd	1.60	3.25	1.00	2.00
Philadelphia	....	1.66	....	1.38
Pittsburgh	....	1.20	....	1.40
St. Louis	.90	1.50	.80	1.25
San Francisco	1.65	....	1.65	....
Seattle, per cu.yd	1.75	....	1.75	....

*Cu.yd.

CRUSHED STONE — Per ton, size 1½-in., carload lots, limestone:

	F.o.b.	Delivered
Atlanta	$1.95	$2.75
Baltimore	....	2.60
Birmingham	.80	1.05
Boston	1.40	1.65
Chicago, per cu.yd, 2,500 lb	....	2.25
Cincinnati	1.65	1.85
Cleveland	....	2.00
Dallas, per cu.yd., 2,500 lb	1.65	3.00
Denver, granite, per cu.yd., 2,700 lb	....	2.50
Detroit	....	1.75
Kansas City (at plant)	1.00	....
Los Angeles	1.35	1.45
Minneapolis	....	1.60
New York, per cu.yd., 2,800@3,000 lb	1.65	3.25
Philadelphia	....	2.00
Pittsburgh	....	2.25
St. Louis	1.35	1.65
San Francisco, trap rock	....	1.65
Seattle, per cu.yd., 3,000 lb	1.10	....

CRUSHED SLAG—Prices for carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Slag Sand
Birmingham	$0.90	$1.15	$2.05	$0.55
Buffalo	1.35	1.35	1.85	1.25
Cleveland	1.70	1.70	....	1.35
Toledo	1.20	1.20	1.20	1.10
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown	1.10	1.20	2.00	.75

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Baltimore (8x12x12)	$0.20	Kansas City	$0.18
Birmingham (5x8x12)	.084	Los Angeles	.125
Boston	.14	Minneapolis	.085
Brooklyn and Queens	.11	Montreal	.12
Chicago	.175	New Orleans	.16
Cleveland	.165	Philadelphia	.15
Denver	.15	Pittsburgh	.18
Detroit	.09	St. Louis	.14

READY MIXED CONCRETE—Per cu.yd., 1:2:4, delivered 50 cu.yd. or more:

Atlanta	$7.75	Los Angeles	$5.40
Birmingham	5.00	Minneapolis	6.00
Boston	6.00	New Orleans	6.05
Cleveland	6.50	New York (Manhattan)	8.50
Cincinnati	5.95	Philadelphia	5.98
Dallas	6.25	Pittsburgh	6.05
Detroit 1:2½:5	4.75	St. Louis	6.80
Kansas City	7.50	Seattle	5.35

HOLLOW TILE—Building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.09	$0.11	$0.13	$0.20	$0.25
Baltimore	.10	.14	.20	.22	.30
Birmingham	.089	.122	.167	.219	.25
Boston	.075	.1065	.1453	.1799	.208
Chicago	.0484	.063	.09	.1179	.13
Cincinnati	.06815	......	......	.165	......
Cleveland	.048	.066	.09	.117	.13
Dallas	.0455	......	......	.117	......
Denver	.085	.135	.175	.19	.25
Detroit	.0505	.065	.0947	.1175	.1305
Kansas City	.0735	.092	.15	.1777	.2072
Los Angeles	.09425	.134	.188	.2325	.3115
Minneapolis	.0635	.09395	.1232	.13425	.2103
New Orleans	.08	......	......	.22	......
New York	.075	.1164	.1455	....	......
Perth Amboy	......	....	....	.2388*	.2956*
Philadelphia	.065	.093	.14	.175	.195
Pittsburgh	.0435	.065	.088	.1165	.126
St. Louis	.058	.082	.112	.155	.19
San Francisco	.0765	.105	.1765	....	....
Seattle	.085	.115	.18	....	....

*At plant. (Load-bearing tile).

BRICK — Prices per thousand in carload lots, as follows:

	Common Backing		Paving F.o.b.
	F.o.b.	Delivered	3x8½x4-in
Atlanta	$8.50	$14.00	$32.00
Baltimore	.....	11.50	43.00†
Birmingham	10.00	12.50	25.00
Boston	11.50	13.00	35.00
Chicago	.....	9.00	32.00
Cincinnati	13.50	16.00	36.50
Cleveland	12.00	14.00	33.00
Dallas	8.50	10.00	25.00†
Denver	13.00	.....	40.00
Detroit	.....	11.50	25.00
Kansas City	12.00	13.00	35.00
Los Angeles	8.50	.....	.....
Minneapolis	.....	7.50	.....
Montreal	21.25	.....	.....
New Orleans	11.00	14.00	40.00
New York	9.50	12.50	45.00
Philadelphia	.....	13.00	40.00
Pittsburgh	11.00	13.00	35.00
St. Louis	.....	11.00	32.00†
San Francisco	.....	14.00	45.00*
Seattle	12.00	14.00	.....

*2½x8½x4 in. †3½x8½x4 in.

LIME — Prices of hydrated, per ton, in paper; lump, per 180-lb. bbl., net:

	Hydrated				Common Lump,	
	Finishing		Common			
	F.o.b.	Delivered	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$13.50	$18.00	$11.50	$15.50	.....	$2.50
Baltimore	.....	20.00	.....	13.00	.....	....
Birmingham	21.00	.....	12.00	.....	$1.65	....
Boston	12.50	15.00	11.50	14.00	2.00*	2.75*
Chicago	.....	20.00	.....	14.00	.....	2.75
Cincinnati	10.00	11.00	8.65	9.65	.....	....
Cleveland	10.50	14.00	8.50	12.00	.....	2.50
Dallas	.....	20.00	.....	.....	.....	2.75
Denver	.....	30.00	.....	22.00	.....	2.85*
Detroit	9.25	14.00	7.25	12.00	.....	....
Kansas City	.475‡	.50‡	.....	.....	.....	2.75
Los Angeles	24.00	26.00	17.00	18.00	.....	2.00
Minneapolis	.....	21.00	.....	19.00	.....	1.70
Montreal	.....	.....	12.00	13.00	.....	....
New Orleans	13.50	21.00	11.00	14.00	1.66	1.95
New York	10.70	14.50	9.45	13.00	2.25*	3.15*
Philadelphia	11.50	15.39	9.90	13.49	.....	1.18
Pittsburgh	10.70	12.20	9.95	11.45	1.85	2.35
St. Louis	.....	.45‡	.....	.40‡	.....	2.15
San Francisco	19.00	.....	19.00	.....	1.59	....
Seattle	.....	32.00	.....	24.00	.....	2.80

*Per 280-lb. bbl. (net.) ‡Per sack.

LIMESTONE—Mill blocks, f.o.b. siding, per cu.ft.:
New York:* Rustic buff, $1.38; Standard gray, $1.48; Standard buff, $1.58; Selected gray, $1.58; Selected buff, $1.68; Variegated, $1.38.
Boston: Rustic buff, $1.37; Standard, $1.57; Selected buff, $1.67.
Pittsburgh: Rustic buff, $1.14; Standard, $1.24 at quarry; Selected buff, $1.34.
Philadelphia: Sel. buff, $1.59; Sel. gray, $1.49; Standard, $1.49; Standard gray, $1.39; Rustic buff, $1.39.
Atlanta: Standard $1.26.
*F.o.b. Bedford, freight allowed to N. Y.

SLATE—Roofing, f.o.b. quarry, Bangor, Pa., net, per square;

No. 1 Clear	$8.25@$9.50
No. 1 Ribbon	6.75@ 7.50
Medium Clear	7.25@ 8.00

Road and Paving Materials

PAVING STONE — Granite, lots of 50,000 blocks, 4x8x4-in., dressed, f.o.b. city:

Atlanta	$3.00 per sq.yd.
Baltimore	43.00 per M.
Birmingham (3½x8½x4-in.)	76.25 per M.
Boston	80.00 per M.
Chicago, 5 in	3.80 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	95.00 per M.
Dallas	25.00 per M.
Detroit, 5 in	2.80 per sq.yd.
Kansas City	2.75 per sq.yd
Minneapolis, 4½ in	2.80 per sq.yd
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in	135.00 per M.
Philadelphia, 4x10x5	115.00 per M.
Pittsburgh	115.00 per M.
St. Louis, 5 in	2.65 per sq.yd

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING — Prices f.o.b., in carload lots:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.00
Chicago	3½	12	1.90
Kansas City	3½	16	2.50
Minneapolis	2½	8	1.65
Montreal	3½	16	2.63
New York	3½	14	1.90
Philadelphia	3½	16	2.02
St. Louis	3½	16	2.00

CURBING—Per lin.ft., 5x16 in., straight, rough, f.o.b., in carload lots:

Atlanta	$0.41	Kansas City	$0.60
Birmingham	.50	New York	.65
Boston	.60	Philadelphia (6x20 dressed)	1.40
Dallas	.60	Pittsburgh	.80
Detroit	.45	St. Louis	.65

ASPHALT—Paving asphalt, f.o.b., per ton. Packages are 350-lb. bbl. or 425-lb. drums, in carload lots:

	Packages	Tank-car or -boat
Atlanta	$21.60	$17.40
Baltimore	19.00	15.00
Birmingham	.....	11.00
Boston	20.00	16.00
Chicago	22.50	15.50
Cincinnati (f.o.b. refinery)	......	8.00
Cleveland	18.25	14.50
Dallas	......	27.00
Denver	27.50	......
Detroit	16.80	12.43
Kansas City (f.o.b. refinery)	19.00	13.00
Los Angeles (f.o.b. refinery)	18.00	12.00
Maurer, N. J. (Bermudez)	......	26.00
Maurer, N. J. (Trinidad)	......	22.00
Minneapolis (f.o.b. Twin Cities)	23.30	18.30
Montreal (f.o.b. factory)	18.66	13.00
New Orleans (f.o.b. refinery)	16.00	12.00
New York	19.00	15.00
Philadelphia	17.00	11.00
Pittsburgh	25.00	16.00
St. Louis	21.70	17.70
San Francisco (f.o.b. refinery)	16.00	10.00
Seattle	21.10	16.00

LIQUID ASPHALT — Residual, hot application, f.o.b., in tank cars. 8,000 gal. minimum, per gal.:

Atlanta	$0.0689
Baltimore	.06
Birmingham	.06
Boston	.07
Cincinnati	.075
Dallas	.05
Kansas City	.05
Los Angeles	.05
Montreal at (refinery)	.09
New York	.06
Philadelphia	.08
Pittsburgh	.05
St. Louis	.07

EMULSIFIED ASPHALT — For penetration and surface treatment, per gal.:

Boston, applied	$0.14
Cincinnati, f.o.b. refinery	.06
Los Angeles, applied	.13
Des Moines, applied	.14
New York, applied	.15
Philadelphia, applied	.15
St. Louis, applied	.13
Seattle, f.o.b. refinery	.08

Iron and Steel

	Pittsburgh	Chicago	Birmingham
STRUCTURAL SHAPES AND PLATES, per 100 lb., base, carload lots	$1.60	$1.70	$1.75
CONCRETE REINFORCING BARS, ¾ in., billet, per 100 lb., carload lots	1.60	1.65	1.75
SHEETS, per 100 lb., carload lots:			
Hot-rolled No. 10	1.50	1.65	1.85
Hot-rolled annealed No. 24	2.05	2.30	2.35
Galvanized No. 24	2.55	2.74	3.00
RIVETS per 100 lb., ¾ in., structural, carload lots	2.25	2.35	2.30
SHEETPILING, per 100 lb., base, carload lots	1.90	2.05	.....
WIRE NAILS, per 100 lb., base, carload lots	1.85	2.05	2.30
HEAVY MELTING STEEL SCRAP, No. 1, per gross ton, at consuming point	8.25	6.75	7@7.50

TRIANGLE MESH—Plain, per 100 sq.ft., in carload lots:

Style Number	Size, In.	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
032	4x4	22	$0.85	$0.86
049	4x4	28	1.07	1.10
068	4x4	35	1.30	1.34
093	4x4	45	1.68	1.72
126	4x4	57	2.08	2.13
153	4x4	68	2.47	2.54
180	4x4	78	2.84	2.92
245	4x4	103	3.75	3.84
287	4x4	119	4.34	4.35
336	4x4	138	5.03	5.16
395	4x4	160	5.83	5.98
036P	4x8	17	.64	.66
053P	4x8	24	.91	.93

TRIANGLE MESH—*Continued*

Style Number	Size, In.	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
072P	4x8	31	1.14	1.17
097P	4x8	40	1.48	1.51
049R	4x8	24	.91	.93
067R	4x8	31	1.14	1.17
089R	4x8	40	1.48	1.51

WIRE ROPE—Discounts from manufacturers' list prices on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	25 %
Galvanized iron rigging and guy rope (add to list)	7½%
Galvanized steel rigging and guy rope	12½%
Plow steel round strand rope	40 %
"Special Steel" and extra strong cast steel, round strand rope	32½%

Discount 5 points less than discount for Eastern territory: California, Colorado, Kansas, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Washington and Wyoming. Discount 10 points less than discount for Eastern territory: Arizona, Idaho, Montana and Utah.

EXPANDED METAL LATH—Per 100 sq.yd., painted, f.o.b., in carload lots 2.2 lb. per sq.yd., standard-mesh diamond lath:

Atlanta	$12.50	Los Angeles	$17.00
Birmingham	17.00	Montreal (2.5 lb.)	24.00
Boston	15.00	New Orleans	20.00
Chicago	10.60	New York	13.50
Cincinnati	11.00	Philadelphia	13.50
Dallas	18.00	Pittsburgh	13.50
Detroit	18.00*	St. Louis	19.00*
Kansas City	17.00*	San Francisco	17.00*
*Delivered.		Seattle	17.00

STEEL FREIGHT RATES — Per 100 lb., effective Dec. 3, 1931, on finished steel products in the Pittsburgh District, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.; 40,000 lb. per car:

Atlanta, 36,000 lb	$0.60	Detroit	$0.285
Baltimore	.29	Kansas City	.59
Birmingham	.60	New Orleans, 36,000 lb.	.69
Boston	.42	New York, 40,000 lb.	.35
Buffalo	.255	Pacific Coast, 60,000 lb.	1.17*
Chicago	.36	Philadelphia	.31
Cincinnati	.285	St. Louis	.41
Cleveland	.205	St. Paul	.60
Denver	.92	* All rail.	

Railway Materials and Supplies

STEEL RAILS — Per gross ton, f.o.b.

	Pittsburgh	Birmingham	Chicago
Standard rails	$40.00	$40.00	$40.00
Light rails	30.00	32.00	30.00
Re-rolled rails	26.00	.....	27.00

RAILWAY TIES — Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$0.90	.....
	Pine, untreated	.85	.....
	Pine, creosoted	1.40	.....
New York	Long-leaf sap pine, untreated	.90	$1.10
	Dense yellow pine, untreated	.65	.85
Birmingham	White oak, untreated	.75	.95
	White oak, creosoted	1.35	1.45
	Southern pine, untreated	.35	.80
	Southern pine, creosoted	.95	1.35
Chicago	White oak, untreated	1.05	1.35
	Oak, empty cell, creosoted	1.40	1.80
	Oak, zinc treated	1.25	1.65
	Southern pine, creosoted	1.15	1.50
Los Angeles	Fir, untreated	.45	....
	Fir, creosoted	1.15	....
Philadelphia	Red oak, untreated	.95	1.15
	Red oak, creosoted	1.47	1.90
St. Louis	White oak, untreated	.85	1.25
	Red oak, untreated	.75	1.15
	Red oak, creosoted	1.12	1.70
	Sap pine or cypress, untreated	.65	1.00
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

TRACK SUPPLIES — Prices per 100 lb., f o.b., for carload lots:

	Pittsburgh	Birmingham	Chicago
Angle bars	$2.55	$2.75	$2.75
Standard spikes	2.40	2.40	2.60
Tie plates	1.75	1.85	1.85
Track bolts	3.50	3.50	3.50

Pipe

WROUGHT STEEL PIPE — Discounts from standard list for delivery from warehouse, except at Pittsburgh, where prices are f.o.b. mill. List prices per ft. as follows: 1-in., 17c.; 3-in., 76½c.; 3½-in., 92c.; 6-in., $1.92.

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Atlanta	44%	36.5%	42%	34%
Chicago	57.25%	44.71%	53.83%	41.29%
Cleveland	53.3%	42.3%	50.8%	37.8%
Denver	44.5%	32%	41%	28.5%
New York	56.14%	43.6%	52.72%	40.18%
Philadelphia	57.28%	44.68%	53.68%	41.80%
Pittsburgh	64%	52.5%	61%	49.5%
St. Louis	51%	38%	48%	35%

Current Prices of Construction Materials

Pipe—Continued

CAST-IRON PIPE — Prices per net ton, for bell and spigot pipe, Class B and heavier, f.o.b. in carload lots; gas pipe and Class A, $3.00 per ton extra:

	4-In.	6-In. and Over
Atlanta	$37.50	$34.50
Boston	41.00	38.00
Birmingham (Base)	33.00	30.00
Burlington (Base)	35.00	32.00
Chicago	41.50	38.50
Dallas	45.50	42.50
Los Angeles	41.50	38.50
New York	38.50	35.50
Philadelphia (rail delivery)	36.50	33.50
Pittsburgh	41.50	38.50
St. Louis	40.50	37.50
San Francisco	41.50	38.50

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.125	$0.21	$0.385	.....	$1.40.	.....	......
Baltimore	.10	.30	.58	.....	1.93	.....	$6.50
Birmingham	.18	.30	.54	$1.02	1.95	$3.50	5.00
Boston	.135	.21	.405	1.325	2.335	4.68	7.175
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.0945	....	.2835	.....	1.125	2.448	......
Cleveland	.135	.21	.405	1.125	2.025	4.824	7.38
Dallas	.23	....	.7165	.....	2.70	.....	......
Denver	.16	.23	.414	.816	1.44	.....	......
Detroit	.135	.22	.415	1.125	2.025	3.80	......
Kansas City	.21	.335	.52	1.00	1.90	3.80	......
Los Angeles(f.o.b.)	.2175	.2825	.5085	1.1865	2.034	3.69	......
Minneapolis	.135	.21	.415	.95	1.72	2.85	3.75
Montreal	.30	.45	.75	1.95	2.60	.....	7.20
New Orleans	.18	.30	.54	1.02	1.95	.....	......
New York	.1575	.25	.475	1.40	2.35	.....	......
Philadelphia	.081	.126	.243	.65	1.17	2.376	4.615
Pittsburgh	.09	.18	.27	.62	1.22	2.45	3.68
St. Louis	.126	.205	.369	.945	1.62	3.20	4.40
San Francisco	.175	.25	.45	1.05	1.80	3.00	4.50
Seattle	.175	.275	.54	1.20	2.00	3.00	5.50

CLAY DRAIN TILE—Per 1,000 lin.ft., f.o.b., in carload lots, 4 in.:

Atlanta	$50.00	Los Angeles	$60.00
Birmingham	50.00	New Orleans	40.00
Boston	45.00	New York	35.00
Chicago	40.00	Philadelphia	36.00
Dallas	65.00	Pittsburgh	80.00
Denver	75.00	St. Louis	40.00
Detroit	45.00	San Francisco	67.50
Kansas City	60.00	Seattle	45.00

Miscellaneous

LINSEED OIL—Raw, in 5-bbl. lots, per lb., f.o.b.:

Atlanta (per gal.)	$0.73	Minneapolis	$0.082
Birmingham	.066	Montreal (per gal.)	.49
Boston (per gal. delivered)	.65	New York	.078
Dallas (per gal.)	.555	Philadelphia	.075
Denver	.104	Seattle (per gal.)	.69
Kansas City (per gal.)	.64	St Louis	.086
Los Angeles	.0973	San Francisco (del)	.1125

WHITE LEAD—In oil, per 100 lb. keg., f.o.b.:

Atlanta	$12.50	Montreal	$ 9.54
Birmingham	12.50	New Orleans	11.00
Boston	11.00	New York	11.00
Dallas	12.00	Philadelphia	9.90
Kansas City	11.13	Seattle	11.50
Los Angeles	11.25	St. Louis	11.00

CHEMICALS—Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.75@2.00
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competion, per ton	21.00
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in bags, per 100 lb.	1.22½
Sulphate of aluminum, in bags, per 100 lb	1.25@1.40
Sulphate of copper, in bbl., per 100 lb.	3.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: *¾-in.*, 6-ft., 1-in.; *⅞-in.*, 4-ft., 5-in.; *1-in.*, 3-ft., 8-in.; *1¼-in.*, 2-ft., 5-in.; *1½-in.*, 1-ft., 8-in. Following prices are per lb. for ¾-in. and larger, delivered in 1,200 ft. coils:

Atlanta	$0.1575	Kansas City	$0.19
Baltimore	.225	Los Angeles	.175
Birmingham	.20	Minneapolis (f.o.b.)	.155
Boston	.135	Montreal	.14
Chicago	.175	New Orleans	.175
Cincinnati (f.o.b.)	.21	New York	.145
Cleveland	.21	Philadelphia	.15
Dallas	.18	St. Louis	.145
Denver	.17	San Francisco	.155
Detroit	.19	Seattle	.155

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point $2.00

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.60

PREPARED ROOFING—Per square, f.o.b., in carload lots:

	Single Shingles*	Strip Shingles†	Rolls‡
Atlanta	$5.00	$5.35	$1.75
Boston	6.00	5.75	2.40
Dallas	4.50	3.75	1.75
Detroit	6.25	6.50	1.85
Montreal	6.40	6.20	2.68
New Orleans	5.60	5.50	2.00
New York	6.50	6.25	2.50
Philadelphia	4.40	4.20	1.65
Seattle	8.75	5.50	2.25
St. Louis	5.76	4.76	1.41

*Slate finish, sufficient to cover 100 sq.ft. ‡Slate surfaced, in rolls weighing 85 to 90 lb †4 in 1, hexagonal shape, with Underwriters' label.

ROOFING MATERIALS—In carload lots, f.o.b.:

	Asphalt Felt, per 100 Lb.	Tar Felt, per 100 Lb.	Asphalt Coating, per Gal.	Tar Pitch* per Ton
Atlanta	$44.50†	$44.50†	$0.45	$44.50
Boston	2.40	2.40	.30	23.00
Dallas	2.75	2.75	.65	34.00
Denver	2.00	2.00	.90	18.00
Montreal	2.62‡	2.02‡	1.40	1.63**
New Orleans	.....	2.50	.....	22.50
New York	2.40	2.40	.34½	28.00
Philadelphia	2.25	2.25	.33	20.00
Seattle	2.40	2.40	.55	27.90
St. Louis	2.52	....	.29	26.00

*In 350 lb. barrels. †Per ton. ‡Per roll. **Per English cwt.

WINDOW GLASS—Discounts from latest jobbers list, dated Sept. 15, 1928 for sizes above first three brackets:

	Single Thickness		Double Thickness	
	A Quality	B Quality	A Quality	B Quality
Atlanta	85%	85%	85%	85%
Birmingham	89%	91%	89%	91%
Boston	88%	90%	87%	89%
Dallas	85%	85%	85%	85%
Denver	84@5%	86@5%	84@5%	86@5%
Kansas City	85%	85%	85%	85%
New York	87%	89%	87%	89%
Philadelphia	88%	90%	88%	90%
Pittsburgh	90%	90%	90%	90%
Seattle	90@10%	90@20%	90@10%	90@20%

EXPLOSIVES—Price per pound for dynamite delivered:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.215	$0.2375	Los Angeles†	$0.1725	$0.1925
Baltimore	.21	.255	Minneapolis	.17	.1875
Birmingham	.13	.1525	Montreal	.1675	.1925
Boston	.215	.24	New Orleans	.19	.22
Chicago	.17	.195	New York	.245	.2675
Cincinnati (f.o.b.)	.22	.245	Philadelphia	.215	.24
Dallas	.2125	.2475	St. Louis	.1375	.1525
Denver	.19*	.21*	San Francisco	.1575	.1825
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*F.o.b Louviers. †F.o.b. arsenal.

Lumber

LUMBER—Per M. ft., b.m., No. 1, Common, rough, in carload lots:

SOUTHERN YELLOW PINE

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†		12 x 12 In.†
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.	F.o.b.
Atlanta	$14.00	......	$15.00	......	$35.00	......	$45.00
Baltimore	......	$40.00	......	$43.00	......	$42.00	35.00
Birmingham	......	15.00	......	15.00	......	18.00	25.00
Boston	24.00	29.00	25.00	30.00	57.00	62.00	57.00
Chicago	......	......	......	......	......	62.50	......
Cincinnati	......	28.00	......	28.00	......	35.00	35.00
Cleveland	30.00	38.00	32.00	40.00	46.00	54.00	......
Dallas	......	35.00	......	35.00	......	50.00	52.50
Denver	......	31.00	......	33.00	......	44.00	50.00
Detroit	30.00	32.00	30.00	32.00	32.00	32.00	45.00
Kansas City	27.00	......	23.00	......	45.00	......	46.00
Minneapolis	......	31.00	......	31.00	......	34.00	......
Montreal	44.00	......	45.00	......	30.00	......	......
New Orleans	......	18.00	......	19.00	......	30.00	......
New York	22.00	24.00	23.00	25 00	50.00	52.50	50.00
Phil. No. 2(com.)	18.00	22.00	19.00	23.00	26.00	30.00	44.00
Pittsburgh	20.00	28.00	20.00	28.00	26.00	36.00	44.00
St. Louis	24.00	29.00	23.50	28.50	42.50	47.50	41.00

DOUGLAS FIR

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†		12 x 12 In.†
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.	F.o.b.
Baltimore	......	$48.00	......	$52.00	......	$58.50	$70 00
Boston	$21.00	26.00	21.00	26.00	$30.00	35.00	35.00
Chicago	......	......	......	......	......	44.52	......
Cincinnati	......	......	......	......	......	42.50	42.50
Cleveland	30.00	38.00	32.00	40.00	40.00	54.00	......
Denver	31.00	......	33.00	......	46.00	......	50.00
Detroit	......	......	......	......	30.00	30.00	45 00
Kansas City	28.00	......	30.00	......	44.00	......	47.00
Minneapolis	......	31.00	......	31.50	......	36.00	......
New Orleans	......	21.00	......	21.00	......	42.50	......
New York	19.00	21.00	20.00	22.00	22.50	24.50	24.00
Philadelphia	......	......	......	......	......	28.00	30 00
Pittsburgh	......	......	......	......	30.00	44.00	30.00
St. Louis	29.00	34.00	29.00	34.00	31.50	36.50	31.50
San Francisco	......	15.00	......	16.00	......	17.00	17.00
Seattle	9.00	10.00	9.00	10.00	11.00	12.00	12.00

*Form lumber, 16 ft. lengths. †Planks and timbers, 20 ft. lengths.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442